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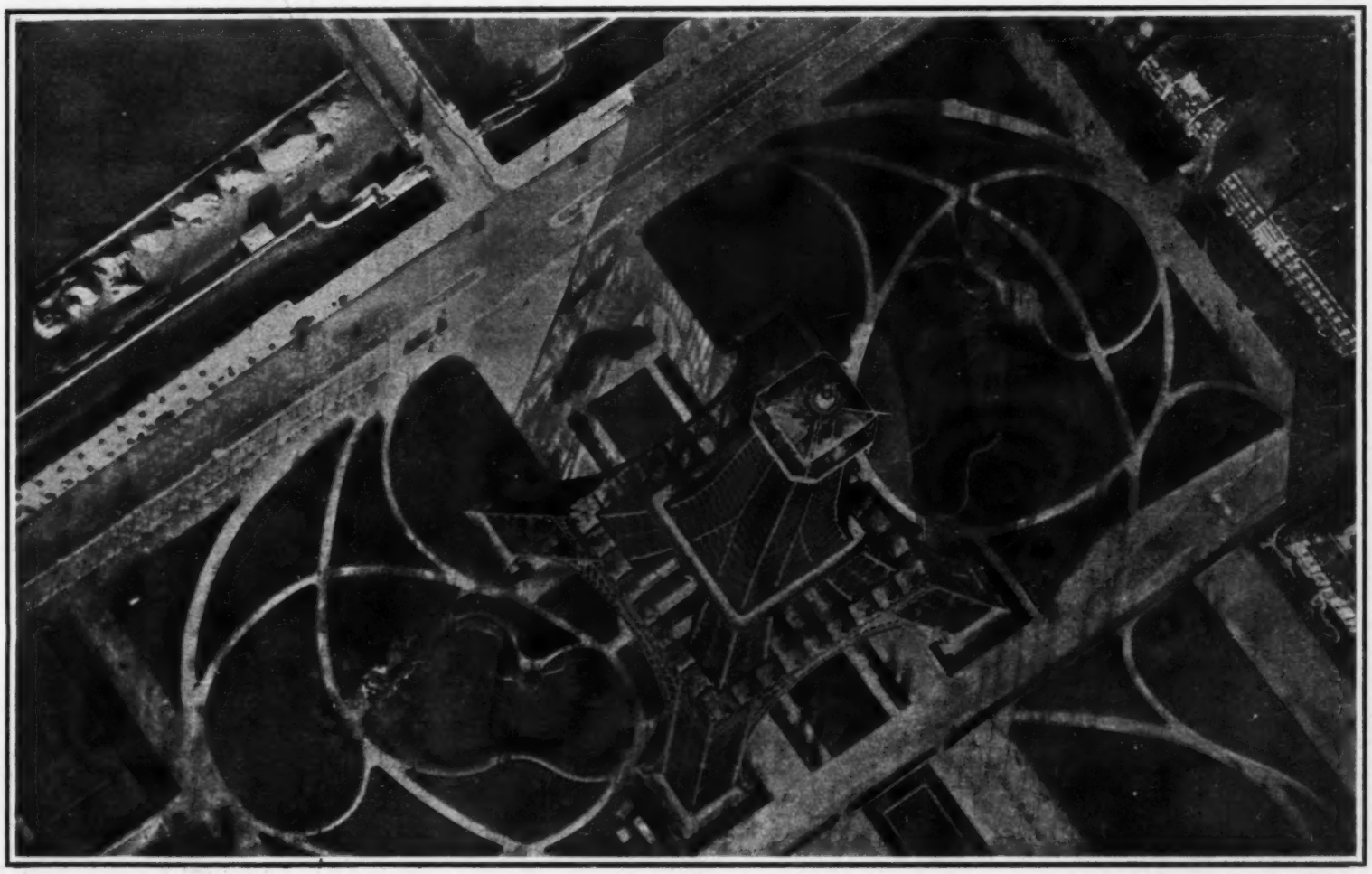
CAPT. SACONNEY'S SYSTEM OF PHOTOGRAPHING FROM KITES.

A PRACTICAL method of aerial photography has long been sought. Very successful results have been obtained in experiments with kites which were recently made on French naval vessels by a system designed by Capt. Saconney.

The first experiments in taking photographs with cameras freely suspended in the air were made in 1884, when several negatives were obtained with the aid of small balloons. Soon afterward better results were obtained with kites. Battut in 1886 substituted a camera for the tail of a kite. Wenz in 1888 attached his camera to the bridle of a kite in such a manner as to facilitate aiming. This method has since been greatly improved and made more practical by its inventor. Eddy used a similar arrangement, but his camera was suspended by a T-shaped piece which further facilitated horizontal aiming. Other systems were designed which closely resembled the one described below. But all this apparatus presented the great inconvenience of being attached rigidly to the cord of the kite. The first rational system which made the camera independent of the cord was that of the American Totten Woglom, who placed his camera in a frame suspended independently from the kite. French military officers, realizing the practical importance of the problem, made many experiments, seeking for the most part to make the apparatus independent of the cord, and to obtain great precision of aim. The true usefulness of aerial photography consists, not in the mere making of pictures, but in the ability either to photograph the enemy's works from a very great distance, in such a manner that plans can be made of them, or to photograph a freely accessible region for the purpose of making maps. In the first case, it is necessary to use telephotographic apparatus. As this has a very limited field, it must be aimed with very great precision. The second object is more simply attained. It is merely necessary to place the camera above the desired points with the lens directed vertically downward. For this purpose a very wide field is required. The field may be enlarged by using panoramic cameras with inclined axes. Cailletet has designed an apparatus comprising eight cameras arranged around a vertical axis. Similar systems have been employed in Russia and Italy, but they offer considerable difficulties in connection with the drawing of plans, so that on the whole, it is better to use a vertical camera and move it as required. It may be asserted that all the systems mentioned above were more or less successful attempts, but that none of them gave a satisfactory solution of the problem. Capt. Saconney's system, on the contrary, allows both of the objects above mentioned to be attained with certainty.

Saconney's experiments were conducted under the auspices of the French navy, from war vessels cruising off the shores of Provence and Morocco. The following is the principle of the method: A camera is suspended from two box kites, which are harnessed together. These kites are raised first, and when the cable forms an angle of 60 deg. with the horizon, the camera, suspended from little wheels rolling on the cable, is hauled up by an auxiliary kite, which can be brought back by a special cable and windlass. The suspension is formed of a light strip of wood which permits the camera to oscillate both about the line of the cable and about an axis perpendicular to the vertical plane of the cable. The camera is, furthermore, so arranged that it can be turned horizontally in any direction and set with its axis exactly horizontal. Two special difficulties are encountered at sea. The limitation of space aboard ship introduces a difficulty in the raising of the kites, which have to be sent up practically from the same point. The first kite is raised by passing its cable over a pulley attached to the top of a mast at the stern of the vessel. In a good wind the kite rises without assistance; in a calm the necessary breeze is created by steaming at the rate of about twenty knots. When the first kite has attained a suitable elevation, the second kite is attached to the cable and in some cases, a third kite is added. The second difficulty is introduced by the motion of the ship. It is met in the following way: The camera is aimed and raised to the desired height, and the exposure is made at the moment when the point to be photographed presents itself at the proper angle. The exposure is made by means of an electrical current which passes up the main cable, through the bronze wheels into the suspended apparatus and returns to the ship by the auxiliary cable and windlass.

From the plates thus obtained, it is possible to make exact plans, including leveling, by graphical methods. Capt. Saconney's system completely solves the problem of aerial photography. The naval administration was so well satisfied with the experiments that it has virtually adopted the system, which will soon be installed on French warships. The entire cost of equipment is less than $500. This includes four kites, a camera with a Zeiss lens, using plates 18 x 24 centimeters (7 x 9½ inches), a small dynamo, cables, and all accessories. The practical character of this solution is indicated by the large size of the plates and the fact that it is possible to raise apparatus weighing 25 pounds to heights exceeding 1,000 feet. The essential principle of the



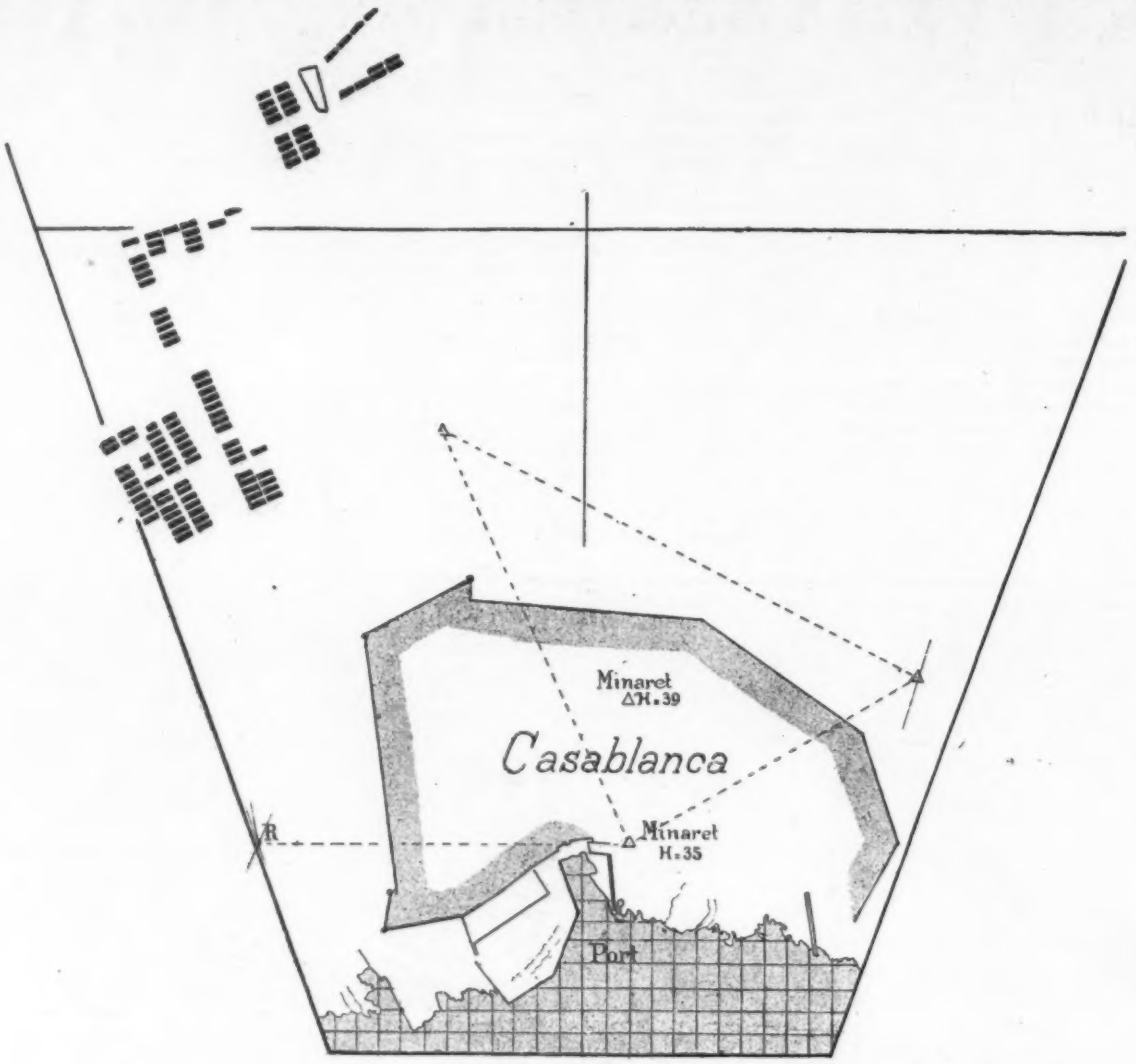
A BIRD'S EYE PHOTOGRAPH OF THE EIFFEL TOWER.

The camera was 100 meters above and 100 meters to the side of the tower, which is 300 meters high.

AERIAL PHOTOGRAPHY.

system is the absolute exclusion of inclined aiming. The axis of the camera is always exactly horizontal, except in the rare cases in which it is vertical. In this way it is possible to make an accurate map, including levels, of a region of any extent, by the use of very simple methods. The military services which this process can perform are obvious. Vessels blockading a port or armies besieging a fortified place can learn the exact nature and contents of the district invested; the location of stores of food and ammunition, batteries, barracks, work-shops, arsenals, etc. Thus the strength and duration of the possible resistance of the place can be estimated and the points upon which it is important to direct artillery fire can be accurately located.

The method, however, has other than military applications. As it will furnish very quickly the data required for charting an unknown region or coast, it will be very useful to colonial and Arctic exploring expeditions. It may also render great service in ordinary land surveying. Its military uses are not confined to blockades and sieges. By locating the enemy's forces, it may, in many cases, take the place of reconnaissances and patrols, thus saving both men and money. In the colonies it will enable difficultly accessible and dangerous regions to be mapped, and will thus serve a humanitarian purpose.



PLAN OF CASABLANCA.

Drawn from a photograph taken from a kite at an elevation of 1,000 feet.

CAPT. SACONNEY'S SYSTEM OF PHOTOGRAPHING FROM KITES.

TESTS FOR LUBRICATING OILS.

Lubricating oils may be tested chemically, physically, or mechanically. Chemical tests are applied to determine the percentages of water, fatty acids, saponifiable matter, and asphalt, and the solubility in 40 parts of benzine.

The principal physical tests determine the density, viscosity, and temperature of ignition. The density should be ascertained because the density of good lubricating oils is restricted to certain limits. The viscosity is measured with Engler's viscometer, in which the velocity of efflux of the oil is compared with that of water. The inflammability is tested by the Pensky-Martens apparatus in which an explosion of the oil vapor takes place when the point of ignition is reached.

The mechanical test is made with Dettmar's apparatus in which a flywheel, the bearings of which are lubricated with the oil, is set revolving at a rate of 2,000 revolutions per minute and allowed to run down. The lubricating power is assumed to be proportional to the time which elapses before the wheel comes to rest. The lubricating power, thus determined, is found to be very nearly inversely proportional to the viscosity as measured with Engler's apparatus. In practice, however, it is found disadvantageous to reduce the viscosity below a certain limit, as very thin oil is squeezed out by the pressure of the shaft on the bearing, especially when the viscosity of the oil is further diminished by the heating effect of friction; and a "hot box" results. The friction may be measured directly with Hoffmann's apparatus, in which a rotating disk tends to draw with it a second disk, pressed against it by an adjustable spring, but separated from it by a layer of the lubricant. The indications are, in general, similar to those of Dettmar's apparatus, but the differences between lubricants are less marked. The locking of the shaft to the bearing, however, depends less on the quality of the lubricant than on the care with which the surfaces have been ground, and so close a relation exists between the viscosity and the lubricating power that, in practice, the expensive, difficultly managed, and not always comparable machines of Dettmar and Hoffmann may well be dispensed with. It is sufficient to apply the chemical tests for purity, to determine the density and temperature of ignition, and to measure the viscosity by Engler's method.

CASEIN IN CELLULOID.

It is chiefly because of its comparative cheapness that casein is added to celluloid. Casein is insoluble in water, alcohol, and the ordinary solvents of nitrocellulose, but is soluble in dilute solutions of borax, ammonia, caustic soda and carbonate of soda. Ammonia is one of the best solvents. 100 parts of casein are triturated with from 16 to 22 parts (by weight) of concentrated ammonia and sufficient water (about 70 parts by weight) to moisten the mass, which in four or five hours becomes transformed into a clear jelly and can be mixed with the nitrocellulose. The odor of the ammoniacal solution, however, is very annoying to the workmen. Borax is a good solvent but produces an opaque jelly. Good results are obtained by mixing 100 parts by weight of casein with 9 parts of borax and 225 parts of water. The mixture is allowed to stand 24 hours in a closed vessel and is then ready for use. Sodium carbonate is likewise an excellent solvent. The following proportions by weight are recommended: casein 1,000 parts, sodium carbonate 15 to 18 parts, water 800 to 850 parts. Some manufacturers use no alkalies, but merely moisten the casein with distilled water, but in the process the gelatinization is effected very slowly during the operation of rolling. A mixture of water and denatured alcohol has also been recommended.

The cylinders of the kneading machine employed for the casein jelly or paste are heated to about 130 deg. F. and set very close together. When, after a variable time, the casein adheres to the cylinders, the distance between these is increased and the back cylinder is cooled. When the casein is reduced to a soft tenacious paste the operation is stopped, as further kneading would make the paste short and brittle. The nitrocellulose, which has meanwhile been kneaded separately with camphor and denatured alcohol, is now fed to a kneading machine heated to 140 deg. F. and the kneaded casein is added gradually, in small pieces. During this final kneading operation the mixed paste is cut frequently in order to produce a uniform and intimate mixture. When this result has been attained, and before the paste begins to harden, it is removed to the press.

In this way nitrocellulose can be mixed with an equal or greater weight of casein, but in order to produce a substance closely resembling ordinary celluloid in appearance and properties, from two to four parts of nitrocellulose, at least, must be combined with one part of casein. The following formulæ for casein celluloid are recommended:

	—Parts by weight.—			
Nitrocellulose	1,000	1,000	1,000	1,000
Camphor	450	400	400	400
Alcohol	600	650	650	600
Casein	500	250	250	200
Water	350	160	190	350
Concentrated ammonia	...	6	7	...
Borax	...	...	...	1/5
Sodium carbonate	12	...	...	...

Casein celluloid is suitable only for articles of second quality. When entirely dry it is inflexible and brittle, but its fragility is temporarily diminished in damp weather.

THE CONDUCTION OF ELECTRICITY.

AN ENGINEERING EXPLANATION OF THE IONIC THEORY.

THE rapid advance of theoretical science in general, and of theoretical electricity in particular, is nearly as bewildering for the physicist and chemist, who is not investigating electrons and ions, as it is for the engineer. The old notions, we are told, are not wrong, but they must be modified in the light of recent research. But as all the progress, great as it is, leaves us practically as ignorant as to the real nature of things as we were before, we welcome general expositions of the actual state of a problem. Such an exposition concerning the conduction of electricity—a cautious guide, not a theory, for which the time has not come yet—has been given in the Zeitschrift für Electrochemie, by Prof. J. Koenigsberger, of Freiberg, in Baden, who has recently accepted a call to the Carnegie Institution of Washington as professor at the geophysical laboratory The following lines are based upon Koenigsberger's communication and other researches. Engineering (London) presents the following abstract of his views:

It is generally acknowledged that electricity is transported either in conjunction with chemical atoms or group of atoms, or unaccompanied by material particles. In the former case we speak of conduction by ions or electrolytic conduction, and we believe electricity to be conducted after this manner in dissolved and fused salts. In the latter case we speak of electrons; and we believe that the conduction of electricity in metals and in cathode rays is due to electrons. Thus we distinguish broadly between electrolytic and metallic conduction. As regards solid compounds not of the metallic type scientists differ. While many scientists would not admit the possibility of metallic or electronic conduction in compounds, others consider, with Koenigsberger, that electronic conduction is much more common than has been assumed, especially in compounds which are not of the salt character, and that the two types of conduction may co-exist. The first chief question is then to look for criteria between ionic and electronic conduction; and Koenigsberger finds five such criteria.

True electrolytic conduction is accompanied by a transport of matter in accordance with Faraday's law. There is nothing of the kind in metallic conduction. This is the first criterion. Some time ago the very careful and prolonged experiments which Riecke, and later Kinsky, had made in this connection attracted attention; no transport of metallic zinc with the current could be observed. Koenigsberger and K. Schilling find that one ampere-hour does not transfer as much as 0.005 gramme of certain sulphides and oxides: PbS, FeS, FeS_2, F_2O_3, Fe_3O_4, BaO, $KAlSi_2O_6$ (a mineral of the feldspar type, known as adular), while the glassy faces of the crystallized heavy barium spar, $BaSO_4$, soon become dim during electrolysis, and show marked electrolytic polarization and liberation of sulphuric acid. The feeble or fair conductivity of the sulphides and oxides mentioned must therefore be metallic, as it is in quartz, for instance, and it has hence been suggested that these minerals and compounds contain some metallic inclosures. But quartz and adular are perfectly transparent and homogeneous, and if lead sulphide were to conduct metallically because it contains metallic lead particles, those particles should make at least 2 per cent of the whole mass.

The finely-divided cloudy particles of lead which Lorenz noticed in the electrolysis of fused lead chlorides, and the particles of metallic sodium which G. von Hevesy assumes in fused sodic hydrate NaOH, do not impart metallic conductivity, for these substances conduct electrolytically. Secondly, whenever there is electrolytic conduction, there is also polarization—that is to say, a counter electromotive force is set up. But no polarization is observed in those sulphides and oxides, in adular not even at 1,070 and 1,300 deg. Cent., when the conduction is quite pronounced, although the strong thermo-currents and Peltier effect make the observations difficult, because they lead to a polarization of the electrons. In fused barium chloride and other salts, on the other hand, the electrolytic polarization is strong.

Another criterion is the formation of ions on dissolving the solid; as a rule substances which are insoluble in water, or form colloidal solutions, conduct metallically, and those which behave like electrolytes in solution conduct electrolytically also in the solid state. A fourth criterion is the change of conductivity with temperature. Metallically conducting compounds have a minimum resistance at a certain temperature (which may lie inconveniently low or high, however), and conduct worse when heated, while the conductivity of electrolytes, solid and liquid, improves with heating. This point will further be discussed presently. A fifth criterion is that electrolytes display selective absorption in the ultra-violet and ultra-red, while metallically conducting substances show continuous absorption and emission.

It is well known that the resistance of metals increases with rising temperature. This holds also for metallically conducting compounds (though they may be poor conductors), and a formula was given by Van't Hoff making this change in the resistance with the temperature dependent upon the heat of dissociation q of the molecule of the substance. That formula did not show, however, that such a compound has a minimum conductivity at a certain temperature, a fact investigated within the last years independently by J. Clay (Leiden), Ch. Lees (London), Niccolai (Rome), and Koenigsberger and Schilling. The new formula of Schilling and Koenigsberger does indicate this minimum conductivity, and as a large number of compounds, comprising lead peroxide, copper oxides, silica, sodium oxide, follow this law, they are believed to conduct metallically.

These determinations are much disturbed, however, by the almost invariable presence of impurities, and the impurities have a particularly strong influence when the heat of dissociation q is small. The q is small, e.g., for iron, hence the great change in the resistance by a small percentage of carbon or silicon. It is very small also for gold. In the case of gold, in fact, the temperature of minimum conductivity cannot be ascertained because (J. Clay) a few thousandths of a per cent of some other substance raise the minimum perceptibly. A very rare case, only known with substances characterized by a high q, is that of potassium iodide, which (K. Bädeker) conducts better when impure with some free iodine than when pure. The conductivities of alloys are partly additive, but their theory is very complicated. Oxides and mixtures of oxides are theoretically simpler. In basic oxides the conductivity is metallic, unless traces of salts make electrolysis possible Quartz, for instance, possesses a slight electrolytic conductivity at low temperatures (Warburg and Tegetmeier). In mixtures of basic and acid oxides the salt character and electrolytic conduction may predominate. This is apparently so in Nernst glowers, but the quantity of electricity transmitted by the glowers is in reality several thousand times greater than would be needed for effecting complete electrolysis (Nernst and Bose), and the conduction must hence chiefly be electronic. In glass (Warburg) and porcelain (Haber), which are essentially mixtures of alkali silicates, with an excess of silica, however, the electrolytic conduction predominates, certainly at temperatures up to 900 deg. Cent.; at very high temperatures the electronic conduction of the other oxides becomes distinct.

The conductivity of liquids (apart from solutions) is electronic, in liquid metals, amalgams (Skaupy), and also in some organic compounds like anthracene and naphthalene (Koenigsberger).

When surrounded by rarefied gases substances which conduct metallically emit negative electrons, provided they are themselves negative electrodes (cathode rays, Wehnelt effect). Substances which conduct electrolytically emit as anodes positive ions (anode rays of Gehrcke and Reichenheim). At high temperatures both metals (Richardson) and oxides (Wehnelt, Jentzsch) split off negative electrons, without being electrodes. When this negative electron can completely escape from the metal without a replenishment of the negative charge (as in the canal rays according to W. Wien), the positively charged metallic atom remains behind, which is not different from the ion of electrolytic dissociation when optically examined in the Bunsen flame or arc.

Although thus the chemical character on the whole indicates the manner in which a compound will conduct the electric current, it is sometimes difficult to say whether or not a body represents a compound of the salt type, and frequently resistance tests have to be made to decide the question of the manner of conduction. The q, the heat of dissociation of the atom, can be deduced from the temperature curves of the resistance, but many of the estimates are so far very uncertain. Some of the estimates for 2 q are the following: For the metals of the sodium group, below 50; calcium group, below 100; aluminium, less than 40; iron, chromium, nickel, manganese, platinum, copper, etc., and the heavy metals in general, below 20; hydrogen, above 500; titanium, about 300; carbon (graphite), 700; silicon, 600; non-metals, above 1,000; phosphorus, 5,000 (but arsenic, antimony, and bismuth, less than 100); tellurium, 1,000; selenium, about 3,000; sulphur and oxygen, much higher; nitrogen, about 10,000; iodine, above 10,000; chlorine, still higher. The following heats of dissociation of compounds (Koenigsberger) are regarded as certain within 5 per cent: Fe_2O_3 (crystallized), 2,600; FeS_2 (pyrites), 480 (markasite), 1,850; FeS, 860; F_3O_4 (magnesite), 1,600, amorphous, 2,500; CuO, 12,000; SiO_2, 22,000. Some quadrivalent elements, like carbon, silicon, and titanium, appear to possess variable heats of dissociation, and these bodies are also anomalous in their specific heats.

In general all electropositive elements (metals) have very small heats of dissociation, some possibly even negative heats of dissociation; the 2 q values of the semi-metals, like arsenic, which cannot easily be deposited electrolytically, range from 50 to 2,000; the 2 q values of the metalloids, the electro-negative elements, which are insulators, are very great. A second rule is that in the periodic table the values of the dissociation heats decrease with increasing atomic weight in each vertical column. The theory connects these heats of dissociation with the splitting off of the negative electron, and says, that in the same vertical column of the periodic system the electro-negative character of the element becomes less pronounced as the atomic weight increases; in other words, the lower members of the series are electro-negative elements, the higher electro-positive. As long as 2 q is less than 40,000, the substance will, according to Koenigsberger, probably conduct metallically, when that value is exceeded electrolytically; this limit is only approximate. The electro-positive elements which, as metals, split off negative electrons, and become positively charged, exist in solution in the state of positive ions which are deposited on the negative electrode, the cathode; these elements have low q values. Those which possess medium q values of about 300 are not readily deposited in electrolysis. Elements with higher q are electro-negative and travel toward the anode.

NEW METALLOTHERMIC REACTIONS.

SOME of the newest mixtures used in metallothermy are composed of silicon, calcium, and magnesium.

Combinations of silicon and calcium have been introduced with the object of producing a liquid slag, composed of calcium silicate, and also in order to facilitate the regulation of the speed of the reaction, by adding the sluggish silicon to the active calcium. The best results are obtained by using an alloy, or silicide, containing 1 part of silicon to 2 parts of calcium. The heating power of this alloy is slightly less than that of aluminium, but the slag is more fluid and solidifies much less quickly. If the proportion of calcium is increased the reaction is accelerated, but the slag becomes less fluid. The calcium silicide is prepared from silicon and lime in the electric furnace or otherwise.

For similar reasons silicon is employed in conjunction with magnesium, but in the state of mechanical mixture, as the production of magnesium silicide is difficult. Silicon does not act energetically on magnesia except at temperatures high enough to volatilize a large proportion of the magnesium reduced. 60 parts of magnesium and 40 parts of silicon form a good mixture, equal in thermal efficiency to aluminium, but the properties are more elastic than those of the silicon-calcium alloy.

In some cases, as where it is necessary to produce simultaneous fusion and simultaneous solidification over the entire area of a junction, the action of aluminium is increased by the addition of calcium. For example, the oxide of chromium is very easily reduced by the combination of calcium and aluminium, but it cannot be reduced by aluminium alone unless chromic acid is present. The slag is a calcium aluminate, which is sufficiently fluid, especially if the proportions used are about 60 parts of aluminium and 40 parts of calcium. The two metals may be fused together, or the calcium may be deposited on the aluminium by electrolysis.

It would be economically advantageous, and probably satisfactory otherwise, to substitute aluminium for part of the calcium which is employed in conjunction with silicon, as described above.

Within the last few months disastrous mine explosions resulting in great loss of life have occurred with such frequent regularity that an investigation of the causes bringing about such accidents in our mines should be made by a legislative commission, so that if possible more successful efforts may be made toward safeguarding the lives of those employed in our coal mines. James Taylor, an Illinois mining inspector, advocates the abolition of the present system of blasting coal as the most effective prevention of mine explosions. While he realizes that it is useless at this time to advocate the return to the lump coal system of mining, nevertheless he believes this to be the surest cure for the reckless use of powder and the lack of proper preparation of shots.

OXHYDRIC PROCESS OF CUTTING METALS.—III.*

TORCHES AND MACHINES THAT CUT STEEL.

BY E. F LAKE.

Concluded from Supplement No. 1755, page 117.

CUTTING UP AN ARMORED CRUISER.

ONE of the most interesting jobs which has been done with this process was the taking apart and cutting into scrap of an old English armored cruiser, which had been bought by a firm in Hamburg.

The method which had been employed formerly was to cut the rivets off, drive them out, remove the armor plate, notch it with compressed air tools and then break it up under a drop. To complete the work by this old method usually took 1½ years. Now, with the oxhydric process, the job was completed in 2½ months.

In Fig. 13 the hull of the boat partly dismantled is shown, and to the right of the picture, the workman is seen cutting up the cast-steel frame for the propeller shaft. The propeller shaft is shown, as it was being cut up, in Fig. 14. It was 18 inches in diameter and the cuts were made in 17 minutes.

The armor plate, as it was being cut up, is shown in Fig. 15. Some of this was 14 inches thick and some of the heaviest guns which were cut up had an outside diameter of more than 40 inches. All the metal in the boat was cut to sizes suitable for charging in the furnaces for remelting.

CUTTING PLATES AND STEEL CASTINGS.

As a manufacturing proposition, the oxhydric process is equally as good as in the cutting up of scrap and Fig. 16 shows a sample of work on which it is very useful. This is a face-plate for the base frame of a locomotive. It was 9/16 inch thick, 4 feet wide by 6 feet long and about 264 lineal inches had to be cut in cutting out the opening. This work was done in exactly one hour, which is at a speed of 3¾ minutes for each running foot.

Many uses for this process will also be found in steel foundries. In Fig. 17 is shown a steel casting just as it comes from the mold, and Fig. 18 shows the same casting after the sprues, risers, etc., have been cut off with the oxhydric process. Fig. 19 shows another steel casting as it came from the sand, and Fig. 20 shows the same casting after the surplus metal has been cut off.

AUTOGENOUS OR FUSION WELDING.

The oxhydric process is also applicable for welding the various metals that can be fused together. The flame, however, must be the opposite of that used for cutting metals, as it must be one that freely reduces the oxide, rather than one causing oxidation, as is used in cutting, as oxides in the welds are inadvisable.

The apparatus used for welding is shown in Fig. 21. By this it will be seen that the same two oxygen and hydrogen bottles are used and that the gas is piped from these to the same mixer that is used in cutting. Here, however, the similarity ceases as the extra nozzle for oxygen is not used. A torch with a single nozzle is substituted and the gas that enters the torch is piped through a single pipe from the mixer; thus only one line of armored hose, leading to the torch, is needed in place of the two.

FIG. 13.—CUTTING CAST-STEEL FRAME FOR PROPELLER SHAFT.

FIG. 14.—CUTTING 18-INCH PROPELLER SHAFT IN 17 MINUTES.

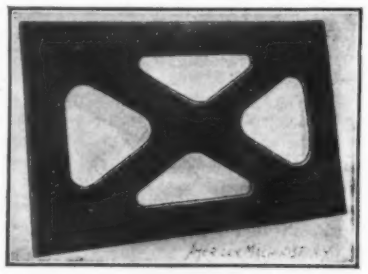


FIG. 16.—HOLES CUT IN PLATE 4 X 6 FEET, $\frac{9}{16}$ INCH THICK.

THE WELDED JOINT.

The welding done by this method leaves the metal its ductility. If the welded joint is submitted to a slight hammering, while it is cooling down to a dull red, or even to a heat treatment after it has cooled, the steel in most cases can be brought back to its original structure and the joints can be made nearly as strong as the original metal.

In welding thick plates, say from ⅜ inch upward, by any of the fusion methods, it is usual to bevel or chamfer the two edges of the joints and fill the V thus formed by melting metal from a rod, with the torch. If the metal is properly fused by this method a fairly good joint is obtained, but if the operator allows globules of metal to fall from the rod and drop on metal which has not been properly melted, the two do not fuse together and a poor joint is the result.

WELDING THICK METAL.

The German Oxhydric Company adopted a different method of welding metals from ⅜ to 1 inch thick, and have made many successful welds thereby. This method is to put the two ends of the metal together without overlapping, but in contact with each other. They are thus heated by two oxhydric torches, one above and the other below the metal, and exactly opposite each other, and are given as extensive a heating zone as possible.

When the metal begins to show signs of melting on the outside, the interior of the sheets are doubtless at a white welding heat; the torches are then removed and an anvil and hammer brought into use for lightly hammering the joint. This causes a readjustment of the molecules, and they join together in the weld.

THE WELDING GASES.

In welding, one part of oxygen to from four to six parts of hydrogen are used, and it is necessary to obtain a complete absorption of the oxygen, by the hydrogen in excess, in order to make a perfectly homogeneous flame. This was a difficult problem to solve as the fear of explosion long prevented the mixing of the two gases before their inflammation.

It was overcome by assuring to the mixture of the gases a velocity greater than the velocity of the propagation of the flame, as an explosive mixture contained in a tube does not ignite instantaneously in all of its

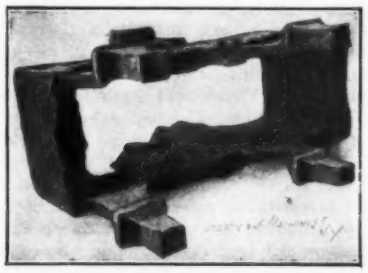


FIG. 17.—STEEL CASTING AS IT LEFT THE MOLD.

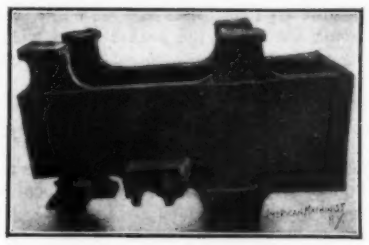


FIG. 18.—SAME CASTING AFTER CUTTING RISERS, SPRUES, ETC.

FIG. 15.—CUTTING UP THE ARMOR PLATE, SOME OF WHICH WAS 14 INCHES THICK.

OXHYDRIC PROCESS OF CUTTING METALS.

* By courtesy of American Machinist.

mass when combustion is started at one end of the tube.

The ignition is propagated in the tube with a finite velocity which increases as the square of the section thereof. If, therefore, the gaseous mass moves toward the point of ignition with a speed greater than the speed of propagation, the flame will not reach the inside of the torch and much less that of the mixer.

Thus, having obtained a minimum for the speed to be given the gas, it is necessary not to exceed the

FIG. 19.—STEEL CASTING AS IT LEFT THE SAND.

FIG. 20.—SAME CASTING AFTER CUTTING OFF EXCESS METAL.

maximum, and this is obtained by a practical consideration, namely, that the jet of gas leaving the torch must not be strong enough to set in motion the drops of the metal which are intended to constitute the weld.

HOW THE GASES OPERATE.

In operation the two gases are carried from the steel bottles to the mixer where they are mixed as previously described from the cutting operation. From the mixer they are carried to the torch through a single tube and enter this where there is a sharp enlargement in its shape. This considerably diminishes the velocity of the gases, and from there they pass through a conical tube that is perfectly smooth on the inside. This tube gradually diminishes in size down to the nozzle, and the speed of the gases gradually increases again until the minimum speed required is obtained.

SAMPLE OF WELDING.

As a sample of some of the fine work which can be done by welding with the oxhydric process, Fig. 22 shows an art piece in which the leaves, petals, stems, and ribbon are worked out by a blacksmith with a hammer and anvil, and the whole was then welded together by welding the leaves and petals to the stem.

THE FORERUNNERS OF THE METALLIC FILAMENT INCANDESCENT LAMP.

By DR. C. RICHARD BÖHM.

THE power of the alkaline earths and of magnesia to emit an intense light when heated was already well known when the electric arc light came into use, and therefore it was only natural that attempts should have been made to use those substances in the electric lighting industry. Early trials made with them proved temporarily successful, but they were superseded by the rapid development of the electric arc and the electric incandescent lamps. Then came the incandescent gas mantle, and the desire to compete with it caused further experiments to be made with a view to utilize these rare earths which had proved so successful with gas.

At first the oxides or salts were mixed with powdered carbon and ground to a paste with an organic binding material, viz., gum, coal-tar, molasses, etc. Out of this paste filaments were formed by pressing, and these, after being coated with carbon powder, were subjected to red heat. Further on, organic fibers or collodion threads were impregnated with solutions of suitable salts, or carbon filaments were used, and these were coated with light-emitting earths or oxides, which may be termed conductors of second class order, or with metals, which are conductors of first class order. Then a filament of metal was given a trial, and for this purpose the metals of the platinum group, which have such a high fusing point, naturally received the first consideration. The manufacture of a filament of osmium, which is so brittle, but has such a high fusing point, offered considerable difficulties. These were, however, overcome by Auer, who with his osmium or osram lamp, put a weapon into the hands of the electric lighting industry which first made it possible to compete on more equal terms with the incandescent gas light.

All the proposals for manufacturing filaments for electric incandescent lamps out of a compound of conductors of first and second class order have hitherto led to no practical result. The reason for this is to be found in the effect of the high temperature in the glowing filament and the subsequent chemical reaction. It is now considered beyond doubt that the formation of carbides plays an important part in the destruction of the filaments of this sort. In this respect the German patent No. 128,925 of 1902 of Just and Falk does not help to overcome the difficulty, because experience has so far taught that filaments cannot be made from zirconium or its oxide without organic binding material. The same may be said of the German patent of Kellner (No. 138,468), according to which the mantles are to consist of thorium or titanium, intermixed with their oxides.

In choosing a filament of carbon or metal in combination with conductors of first and second class order, it must be remembered that the outside coating of oxide will have a section five or six times as large as that of the core. In order to create the heat for making the filament glow, a current of such strength has to be carried by the core that it would also be volatilized. The alternative way is to coat a core composed of conductors of second class order with a conductor of first class order. Such a proposal is to be found in the classical patent of Jablochkoff and in an English patent.

By using mixtures of two or three oxides instead of magnesia or zirconia (with yttrium oxide, for instance), Nernst filaments were obtained; these require heating mechanisms. Scharf wanted to avoid this drawback by a combination of oxides and metals, an idea which is again met with in the German patent 128,925. According to this patent the filament is composed of a metal (Zr) and an oxide (ZrO_2). If we consider all oxides as conductors of second class order, then Bolton's idea is more to the point, as he proposes in the German patent No. 161,081 that the lower oxide of tantalum, which is to carry the electric current, shall be mixed with the non-conducting oxide of zirconium (ZrO_2), then turned into a thread, which is to be heated by the electric current in the usual way. By this process the oxide of tantalum is reduced to the metallic state, whereas the zirconium oxide is left unaltered, but in a very fine state of subdivision. This circumstance should prove a matter of great importance in the manufacture of filaments from conductors of the first and second class order, as it has been ascertained that the original materials must be in a state of the finest possible division, and this condition can ordinarily only be attained with the greatest difficulty. It is a well-known fact that it is almost impossible to mix the more or less ductile metals intimately with oxides.

Although the idea of Bolton was perfectly correct, he was foiled through the great affinity of tantalum metal for hydrogen, and therefore it was impossible to manufacture useful filaments according to his German patent No. 161,081. The metal wolfram or tungsten does not offer the same drawback, because a compound of tungstic acid with conductors of the second class can be heated in a current of hydrogen to the point of the reduction to the metal, and thus the desired fine division of conductors of first and second class order may be obtained. Acccording to a later patent, specified quantities of ThO_2 and ZrO_2 mixed with tungstic acid are fused together in an iridium crucible by means of an oxyhydrogen blow-pipe, and the highly refractory tungsten compounds are then pulverized. If this product is then heated in a current of hydrogen, a combination of conductors of first and second class order in the finest division will be the result. If anyone did succeed in manufacturing filaments composed of metals and oxides of metals in a fine state of division, it could be said that the heater and filament of the Nernst lamp had been united in one single thread. It can be gathered from the German patent 187,083 that the latest endeavors are being directed toward this end, as according to this patent the conductor of the first class order consists of metallic tungsten, or a tungsten alloy, whereas the rare earths (ZrO_2) and ytterit earths are selected for conductors of the second order.

At present no satisfactory way of doing away with the organic binding material appears to have been discovered, and as the rare earths easily unite with carbon, the resulting filaments must contain carbide. It may be mentioned that Léon de Somzée of Brussels protected in 1899 a filament made of silicon to which he added some rare earths (oxides) for the purpose of increasing the emission of light.

Tungsten carbide, which is formed intermittently, is decomposed at the temperature of the glowing filament, so that metallic tungsten is left, and the carbon is, as

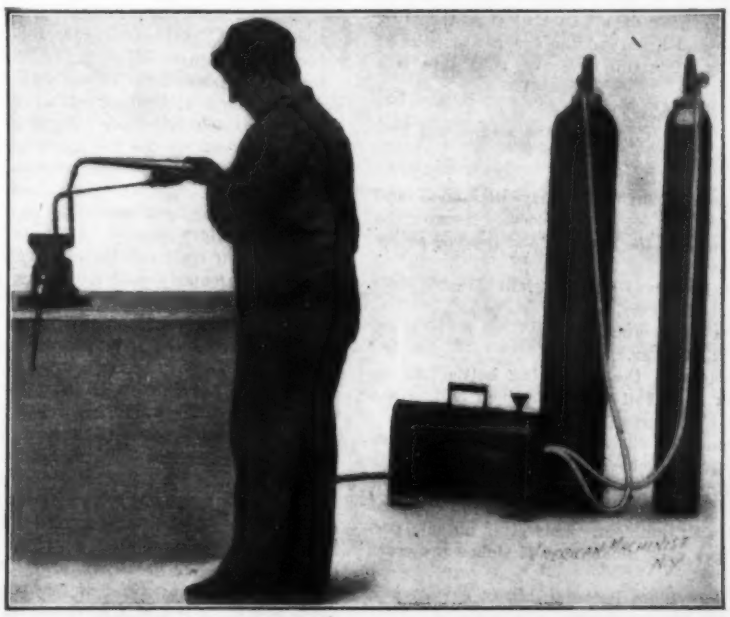


FIG. 21.—THE OXHYDRIC WELDING APPARATUS AT WORK.

FIG. 22.—WELDING LEAVES AND PETALS ON BLACKSMITH'S ART WORK.

OXHYDRIC PROCESS OF CUTTING METALS.

we may say, distilled out of it. This peculiarity and the slight affinity of tungsten for hydrogen have led to the important position which tungsten now holds in the metallic filament lamp industry. Molybdenum, which is closely related to tungsten, cannot by itself be made to yield threads, but it has a favorable influence if it is added in small proportions to tungsten. Titanium, which has often been recommended for such purposes, is sure to become of importance in the industry, but the same cannot be said of silicon, which, of late, American inventors have recommended.—The Engineer.

CANNING AND PRESERVING FRUIT.—IV.*

HINTS FOR THE HOUSEWIFE.

BY MARIA PARLOA.

Concluded from Supplement No. 1755, page 123.

CANNED FRUIT COOKED IN A WATER BATH.

PREPARE the fruit and syrup as for cooking in the oven.

Fill the sterilized jars and put the covers on loosely. Have a wooden rack in the bottom of a wash boiler Put in enough warm water to come to about 4 inches above the rack. Place the filled jars in the boiler, but do not let them touch one another. Pack clean white cotton rags, or perhaps better, cotton rope, between and around the jars to prevent them from striking one another when the water begins to boil. Cover the boiler and let the fruit cook ten minutes from the time the water surrounding it begins to boil.

Draw the boiler back and take off the cover. When the steam passes off take out one jar at a time and place in a pan of boiling water beside the boiler, fill up with boiling syrup, and seal. Put the jars on a board and do not let cold air blow upon them. If screw covers are used tighten them when the glass has cooled and contracted.

PRESERVING FRUIT.

In the case of most fruits, canning with a little sugar is to be preferred to preserving with a large quantity of sugar. There are, however, some fruits that are only good when preserved with a good deal of sugar. Of course such preparations of fruit are only desirable for occasional use. The fruits best adapted for preserving are strawberries, sour cherries, sour plums, and quinces. Such rich preparations should be put up in small jars or tumblers.

Strawberries.

Use equal weights of sugar and strawberries. Put the strawberries in the preserving kettle in layers, sprinkling sugar over each layer. The fruit and sugar should not be more than 4 inches deep. Place the kettle on the stove and heat the fruit and sugar slowly to the boiling point. When it begins to boil skim carefully. Boil ten minutes, counting from the time the fruit begins to bubble. Pour the cooked fruit into platters, having it about 2 or 3 inches deep. Place the platters in a sunny window, in an unused room, for three or four days. In that time the fruit will grow plump and firm, and the syrup will thicken almost to a jelly. Put this preserve, cold, into jars or tumblers.

White Currants.

Select large, firm fruit, remove the stems, and proceed as for strawberries.

Cherries.

The sour cherries, such as Early Richmond and Montmorency, are best for this preserve. Remove the stems and stones from the cherries and proceed as for strawberry preserve.

Cherries Preserved with Currant Juice.

12 quarts of cherries.
3 quarts of currants.
2 quarts of sugar.

Put the currants in the preserving kettle and on the fire. When they boil up crush them and strain through cheese cloth, pressing out all the juice.

Stem and stone the cherries, being careful to save all the juice. Put the cherries, fruit juice, and sugar in the preserving kettle. Heat to the boiling point and skim carefully. Boil for twenty minutes. Put in sterilized jars or tumblers. This gives an acid preserve. The sugar may be doubled if richer preserves are desired.

Plum Preserve.

4 quarts of green gages.
2 quarts of sugar.
1 pint of water.

Prick the fruit and put it in a preserving kettle. Cover generously with cold water. Heat to the boiling point and boil gently for five minutes. Drain well.

Put the sugar and water in a preserving kettle and stir over the fire until the sugar is dissolved. Boil five minutes, skimming well. Put the drained green gages in this syrup and cook gently for twenty minutes. Put in sterilized jars.

Other plums may be preserved in the same manner. The skins should be removed from white plums.

Quinces.

4 quarts of pared, quartered, and cored quinces.
2 quarts of sugar.
1 quart of water.

Boil the fruit in clear water until it is tender, then skim out and drain.

Put the 2 quarts of sugar and 1 quart of water in the preserving kettle; stir until the sugar is dissolved. Let it heat slowly to the boiling point. Skim well and boil for twenty minutes. Pour one-half of the syrup into a second kettle. Put one-half of the cooked and drained fruit into each kettle. Simmer gently for half an hour, then put in sterilized jars. The water in which the fruit was boiled can be used with the parings, cores, and gnarly fruit to make jelly.

Fruit Purées.

Purées of fruit are in the nature of marmalades, but they are not cooked so long, and so retain more of the natural flavor of the fruit. This is a particularly nice way to preserve the small, seedy fruits, which are to be used in puddings, cake, and frozen desserts.

Free the fruit from leaves, stems, and decayed portions. Peaches and plums should have the skins and stones removed. Rub the fruit through a purée sieve. To each quart of the strained fruit add a pint of sugar. Pack in sterilized jars. Put the covers loosely on the jars. Place the jars on the rack in the boiler. Pour in enough cold water to come half way up the sides of the jars. Heat gradually to the boiling point and boil thirty minutes, counting from the time when the water begins to bubble.

Have some boiling syrup ready. As each jar is taken from the boiler put it in a pan of hot water and fill up with hot syrup. Seal at once.

Marmalades.

Marmalades require great care while cooking because no moisture is added to the fruit and sugar. If the marmalade is made from berries the fruit should be rubbed through a sieve to remove the seeds. If large fruit is used have it washed, pared, cored, and quartered.

Measure the fruit and sugar, allowing one pint of sugar to each quart of fruit.

Rinse the preserving kettle with cold water that there may be a slight coat of moisture on the sides and bottom. Put alternate layers of fruit and sugar in the kettle, having the first layer fruit. Heat slowly, stirring frequently. While stirring, break up the fruit as much as possible. Cook about two hours, then put in small sterilized jars.

Fruit Preserved in Grape Juice.

Any kind of fruit can be preserved by this method, but it is particularly good for apples, pears, and sweet plums. No sugar need be used in this process.

Boil 6 quarts of grape juice in an open preserving kettle, until it is reduced to 4 quarts. Have the fruit washed and pared, and, if apples or pears, quartered and cored. Put the prepared fruit in a preserving kettle and cover generously with the boiled grape juice. Boil gently until the fruit is clear and tender, then put in sterilized jars.

Boiled Cider.

When the apple crop is abundant and a large quantity of cider is made, the housekeeper will find it to her advantage to put up a generous supply of boiled cider. Such cider greatly improves mince meat, and can be used at any time of the year to make cider apple sauce. It is also a good selling article.

The cider for boiling must be perfectly fresh and sweet. Put it in a large, open preserving kettle and boil until it is reduced one-half. Skim frequently while boiling. Do not have the kettle more than two-thirds full.

Put in bottles or stone jugs.

Cider Apple Sauce.

5 quarts of boiled cider.
8 quarts of pared, quartered, and cored sweet apples.

Put the fruit in a large preserving kettle and cover with the boiled cider. Cook slowly until the apples are clear and tender. To prevent burning, place the kettle on an iron tripod or ring. It will require from two to three hours to cook the apples. If you find it necessary to stir the sauce be careful to break the apples as little as possible. When the sauce is cooked, put in sterilized jars.

In the late spring, when cooking apples have lost much of their flavor and acidity, an appetizing sauce may be made by stewing them with diluted boiled cider, using 1 cupful of cider to 3 of water.

Cider Pear Sauce.

Cooking pears may be preserved in boiled cider the same as sweet apples. If one prefers the sauce less sour, 1 pint of sugar may be added to each quart of boiled cider.

Methods of Making Jelly.

In no department of preserving does the housekeeper feel less sure of the result than in jelly making. The rule that works perfectly one time fails another time. Why this is so the average housekeeper does not know; so there is nearly always an element of uncertainty as to the result of the work. These two questions are being constantly asked: "Why does not my jelly harden?" "What causes my jelly to candy?"

It is an easy matter to say that there is something in the condition of the fruit, or that the fruit juice and sugar were cooked too short or too long a time. These explanations are often true; but they do not help the inquirer, since at other times just that proportion of sugar and time of cooking have given perfect jelly. Herewith an attempt is made to give a clear explanation of the principles underlying the process of jelly making. It is believed that the women who study this carefully will find the key to unvarying success in this branch of preserving.

Pectin, Pectose, Pectase.

In all fruits, when ripe or nearly so, there is found pectin, a carbohydrate somewhat similar in its properties to starch. It is because of this substance in the fruit juice that we are able to make jelly. When equal quantities of sugar and fruit juice are combined and the mixture is heated to the boiling point for a short time, the pectin in the fruit gelatinizes the mass.

It is important that the jelly maker should understand when this gelatinizing agent is at its best. Pectose and pectase always exist in the unripe fruit. As the fruit ripens the pectase acts upon the pectose, which is insoluble in water, converting it into pectin, which is soluble. Pectin is at its best when the fruit is just ripe or a little before. If the juice ferments, or the cooking of the jelly is continued too long, the pectin undergoes a change and loses its power of gelatinizing. It is therefore of the greatest importance that the fruit should be fresh, just ripe or a little underripe, and that the boiling of the sugar and juice should not be continued too long.

Fruits vary as to the quantities of sugar, acid, pectin, and gums in their composition. Some of the sour fruits contain more sugar than do some of the milder-flavored fruits. Currants, for example, often contain four or five times as much sugar as the peach. The peach does not contain so much free acid, and it does contain a great deal of pectin bodies, which mask the acid; hence the comparative sweetness of the ripe fruit.

Selection and Handling of Fruit for Jelly Making.

An acid fruit is the most suitable for jelly making, though in some of the acid fruits, the strawberry, for example, the quantity of the jelly-making pectin is so small that it is difficult to make jelly with this fruit. If, however, some currant juice be added to the strawberry juice, a pleasant jelly will be the result; yet, of course, the flavor of the strawberry will be modified. Here is a list of the most desirable fruits for jelly making. The very best are given first: Currant, crab apple, apple, quince, grape, blackberry, raspberry, peach.

Apples make a very mild jelly, and it may be fla-

* Reprint of Farmers' Bulletin 360, issued by the Department of Agriculture.

vered with fruits, flowers, or spices. If the apples are acid it is not advisable to use any flavor.

Juicy fruits, such as currants, raspberries, etc., should not be gathered after a rain, for they will have absorbed so much water as to make it difficult, without excessive boiling, to get the juice to jelly.

If berries are sandy or dusty it will be necessary to wash them, but the work should be done very quickly so that the fruit may not absorb much water.

Large fruits, such as apples, peaches, and pears, must be boiled in water until soft. The strained liquid will contain the flavoring matter and pectin.

It requires more work and skill to make jellies from the fruits to which water must be added than from the juicy fruits. If the juicy fruits are gathered at the proper time one may be nearly sure that they contain the right proportion of water. If gathered after a rain the fruit must be boiled a little longer so that the superfluous water may pass off in steam.

In the case of the large fruits a fair estimate is 3 quarts of strained juice from 8 quarts of fruit and about 4 quarts of water. If the quantity of juice is greater than this it should be boiled down to 3 quarts.

Apples will always require 4 quarts of water to 8 quarts of fruit, but juicy peaches and plums will require only 3 or 3½ quarts.

The jelly will be clearer and finer if the fruit is simmered gently and not stirred during the cooking.

It is always best to strain the juice first through cheese cloth and without pressure. If the cloth is double the juice will be quite clear. When a very clear jelly is desired the strained juice should pass through a flannel or felt bag. The juice may be pressed from the fruit left in the strainer and used in marmalade or for a second-quality jelly.

To make jelly that will not crystallize (candy) the right proportion of sugar must be added to the fruit juice. If the fruit contains a high percentage of sugar, the quantity of added sugar should be a little less than the quantity of fruit juice. That is to say, in a season when there has been a great deal of heat and sunshine there will be more sugar in the fruit than in a cold, wet season; consequently, 1 pint of currant juice will require but three-quarters of a pint of sugar. But in a cold, wet season the pint of sugar for the pint of juice must be measured generously.

Another cause of the jelly crystallizing is hard boiling. When the syrup boils so rapidly that particles of it are thrown on the upper part of the sides of the preserving kettle they often form crystals. If these crystals are stirred into the syrup they are apt to cause the mass to crystallize in time.

The use of the syrup gage and care not to boil the syrup too violently would do away with all uncertainty in jelly making. The syrup gage should register 25 deg., no matter what kind of fruit is used.

Jellies should be covered closely and kept in a cool, dry, dark place.

Currant Jelly.

The simplest method of making currant jelly is perhaps the following: Free the currants from leaves and large stems. Put them in the preserving kettle; crush a few with a wooden vegetable masher or spoon; heat slowly, stirring frequently.

When the currants are hot, crush them with the vegetable masher. Put a hair sieve or strainer over a large bowl; over this spread a double square of cheese cloth. Turn the crushed fruit and juice into the cheese cloth, and let it drain as long as it drips, but do not use pressure. To hasten the process take the corners of the straining cloth firmly in the hands and lift from the sieve; move the contents by raising one side of the cloth and then the other. After this put the cloth over another bowl. Twist the ends together and press out as much juice as possible. This juice may be used to make a second quality of jelly.

The clear juice may be made into jelly at once, or it may be strained through a flannel bag. In any case, the method of making the jelly is the same.

Measure the juice, and put it in a clean preserving kettle. For every pint of juice add a pint of granulated sugar.

Stir until the sugar is dissolved, then place over the fire; watch closely, and when it boils up draw it back and skim; put over the fire again, and boil and skim once more; boil and skim a third time; then pour into hot glasses taken from the pan of water on the stove and set on a board. Place the board near a sunny window in a room where there is no dust. It is a great protection and advantage to have sheets of glass to lay on top of the tumblers. As soon as the jelly is set cover by one of the three methods given.

To make very transparent currant jelly, heat, crush, and strain the currants as directed in the simplest process. Put the strained juice in the flannel bag and let it drain through. Measure the juice and sugar, pint for pint, and finish as directed above.

To make currant jelly by the cold process follow the first rule for jelly as far as dissolving the sugar in the strained juice. Fill warm, sterilized glasses with this. Place the glasses on a board and put the board by a sunny window. Cover with sheets of glass and keep by the window until the jelly is set. The jelly will be more transparent if the juice is strained through the flannel bag. Jelly made by the cold process is more delicate than that made by boiling, but it does not keep quite so well.

Raspberry and Currant Jelly.

Make the same as currant jelly, using half currants and half raspberries.

Raspberry Jelly.

Make the same as currant jelly.

Blackberry Jelly.

Make the same as currant jelly.

Strawberry Jelly.

To 10 quarts of strawberries add 2 quarts of currants and proceed as for currant jelly, but boil fifteen minutes.

Ripe-Grape Jelly.

An acid grape is best for this jelly. The sweet, ripe grapes contain too much sugar. Half-ripe fruit, or equal portions of nearly ripe and green grapes, will also be found satisfactory. Wild grapes make delicious jelly. Make the same as currant jelly.

Green-Grape Jelly.

Make the same as apple jelly.

Plum Jelly.

Use an under-ripe acid plum. Wash the fruit and remove the stems. Put into the preserving kettle with 1 quart of water for each peck of fruit. Cook gently until the plums are boiled to pieces. Strain the juice and proceed the same as for current jelly.

Apple Jelly.

Wash, stem, and wipe the apples, being careful to clean the blossom end thoroughly. Cut into quarters and put into the preserving kettle. Barely cover with cold water, about 4 quarts of water to 8 of apples) and cook gently until the apples are soft and clear. Strain the juice and proceed as for currant jelly. There should be but 3 quarts of juice from 8 quarts of apples and 4 of water.

Apples vary in the percentage of sugar and acid they contain. A fine-flavored acid apple should be employed when possible. Apple jelly may be made at any time of the year, but winter apples are best and should be used when in their prime, i. e., from the fall to December or January. When it is found necessary to make apple jelly in the spring, add the juice of one lemon to every pint of apple juice.

Cider Apple Jelly.

Make the same as plain apple jelly, but covering the apples with cider instead of water. The cider must be fresh from the press.

Crab-Apple Jelly.

Make the same as plain apple jelly.

Quince Jelly.

Rub the quinces with a coarse crash towel; cut out the blossom end. Wash the fruit and pare it and cut in quarters. Cut out the cores, putting them in a dish by themselves. Have a large bowl half full of water; drop the perfect pieces of fruit into this bowl. Put the parings and imperfect parts, cut very fine, into the preserving kettle. Add a quart of water to every 2 quarts of fruit and parings. Put on the fire and cook gently for two hours. Strain and finish the same as apple jelly. The perfect fruit may be preserved or canned.

To make quince jelly of a second quality, when the parings and fruit are put on to cook put the cores into another kettle and cover them generously with water and cook two hours. After all the juice has been drained from the parings and fruit, put what remains into the preserving kettle with the cores. Mix well and turn into the straining cloth. Press all the juice possible from this mixture. Put the juice in the preserving kettle with a pint of sugar to a pint of juice; boil ten minutes.

Wild Fruits for Jellies.

Wild raspberries, blackberries, barberries, grapes, and beach plums all make delicious jellies. The frequent failures in making barberry jelly come from the fruit not being fresh or from being overripe.

Preparation of the Glasses for Jelly.

Sterilize the glasses; take from the boiling water and set them in a shallow baking pan in which there is about 2 inches of boiling water.

Covering Jellies.

Jellies are so rich in sugar that they are protected from bacteria and yeasts, but they must be covered carefully to protect them from mold spores and evaporation. The following methods of covering jellies are all good:

Have disks of thick white paper the size of the top of the glass. When the jelly is set, brush the top over with brandy or alcohol. Dip a disk of paper in the spirits and put it on the jelly. If the glasses have covers, put them on. If there are no covers, cut disks of paper about half an inch in diameter larger than the top of the glass. Beat together the white of one egg and a tablespoonful of cold water. Wet the paper covers with this mixture and put over the glass, pressing down the sides well to make them stick to the glass; or the covers may be dipped in olive oil and be tied on the glasses, but they must be cut a little larger than when the white of egg is used.

A thick coating of paraffin makes a good cover, but not quite so safe as the paper dipped in brandy or alcohol, because the spirits destroy any mold spores that may happen to rest on the jelly. If such spores are covered with the paraffin they may develop under it. However, the paper wet with spirits could be put on first and the paraffin poured over it.

If paraffin is used, break it into pieces and put in a cup. Set the cup in a pan of warm water on the back of the stove. In a few moments it will be melted enough to cover the jelly. Have the coating about a fourth of an inch thick. In cooling the paraffin contracts, and if the layer is very thin it will crack and leave a portion of the jelly exposed.

CANNED OR BOTTLED FRUIT JUICES.

Fruit juice is most desirable for drinking or for culinary purposes. Grape juice is particularly good as a drink. It may be canned with or without sugar but, except where the grapes have a large percentage of sugar, as is the case in California, some sugar should be added to the juice in canning.

Currant juice may be sterilized and canned without sugar. This juice may be made into jelly at any season of the year.

Fruit juices that are designed for use in frozen creams and water ices should be canned with a generous amount of sugar.

For grape juice good bottles are to be preferred to fruit cans. If you can get the self-sealing bottles, such as pop or beer comes in, the work of putting up grape juice will be light. If bottles are employed, be very careful to sterilize both bottles and corks.

Grape Juice.

Wash the grapes and pick from the stems. Put the fruit in the preserving kettle and crush slightly. Heat slowly and boil gently for half an hour. Crush the fruit with a wooden spoon.

Put a sieve or colander over a large bowl and spread a square of cheese cloth over the sieve. Turn the fruit and juice into the cheese cloth; drain well, then draw the edges of the cheese cloth together and twist hard to press out all the juice possible.

Put the strained juice in a clean preserving kettle and on the fire. When it boils up, draw back and skim. Let it boil up again and skim; then add the sugar and stir until dissolved. Boil five minutes, skimming carefully. Fill hot sterilized jars or bottles. Put the jars or bottles in a moderate oven for ten minutes, in pans of boiling water. Have some boiling juice and pour a little of it into the jars as they are taken from the oven; then seal. Place on boards and set aside out of a cold draft.

A good proportion of sugar and juice is 1 gill of sugar to a quart of juice. The preparation and use of grape juice has been discussed at length in an earlier bulletin of this series.*

Raspberry, Blackberry, Strawberry, and Currant Juices.

With all these fruits except currants, proceed the same as for grape juice, but adding half a pint of sugar to each quart of juice. Currants will require 1 pint of sugar to a quart of juice.

Cherry, Plum, and Peach Juices.

To preserve the juice of cherries, plums, peaches, and similar fruits, proceed as for jelly, but adding to each quart of juice half a pint of sugar instead of a quart as for jelly. If it is not desired to have the fruit juice transparent, the pulp of the fruit may be pressed to extract all the liquid.

Fruit Syrups.

The only difference between syrups and juice is that in the syrup there must be at least half as much sugar as fruit juice.

These syrups are used for flavoring ice creams and water ices. They also make a delicious drink, when two or three spoonfuls are added to a glass of ice water.

Raspberry Vinegar.

Put 4 quarts of raspberries in a bowl and pour over them 2 quarts of vinegar. Cover and set in a cool place for two days. On the second day strain the vinegar through cheese cloth. Put 4 quarts of fresh raspberries in the bowl and pour over them the vinegar strained from the first raspberries. Put in a cool place for two days, then strain. Put the strained juice in a preserving kettle with 3 quarts of sugar. Heat slowly, and when the vinegar boils skim carefully. Boil twenty minutes, then put in sterilized bottles.

About 2 tablespoonfuls of vinegar to a glass of water makes a refreshing drink.

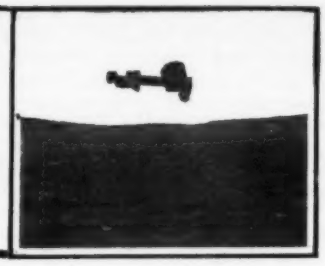
Similar vinegars may be made from blackberries and strawberries.

The Mersey Docks and Harbor Board's new dredger, the "Leviathan," is lifting from the approaches to the Mersey 300,000 tons of sand a week, and already two feet have been added to the depth of water at the bar.

* U. S. Dept. Agr. Farmers' Bulletin No. 175.

M. LOUIS BLERIOT AND HIS AEROPLANES.

FULL DESCRIPTION OF THE LATEST SUCCESSFUL MONOPLANES OF THIS CELEBRATED FRENCH ENGINEER.



THE flight across the English Channel, which was made by M. Bleriot on the 25th ultimo, is the culmination of a long series of experiments in aviation which have been carried on persistently during the last decade.

M. Bleriot graduated from the Central School of Arts and Manufactures of Paris in 1895. His first successful invention was an acetylene lamp for automobiles. Beginning with the year 1900, he began to experiment with the idea of building a practical flying machine. His first step in this direction was in the form of an artificial bird with flapping wings actuated by a light carbonic-acid motor. In 1904 he abandoned this apparatus and began to experiment with aeroplanes. At first he tried the biplane type. One of these machines was tried upon floats on the water, and this, as well as other of his early machines, have already been described by us in the SUPPLEMENT. Next he adopted the Langley type of following-plane apparatus. He developed this to a point where he was able to make some excellent flights; and the monoplanes which he is building at the present time grew out of this machine. He found the following surface unnecessary, and gradually contracted it until his machine assumed the form of a monoplane with a short tail.

The Nos. IV., V., and VI. were experimented with in the years 1905, 1906, and 1907, while last year he made many successful flights with his Nos. VIII. and IX. The No. XI. machine was brought out early in the present year, but it was not until recently that M. Bleriot made record flights with it. The No. XII. machine, which was constructed the early part of the present summer, is somewhat more powerful and has carried as many as three people, or a total weight of 1,234 pounds.

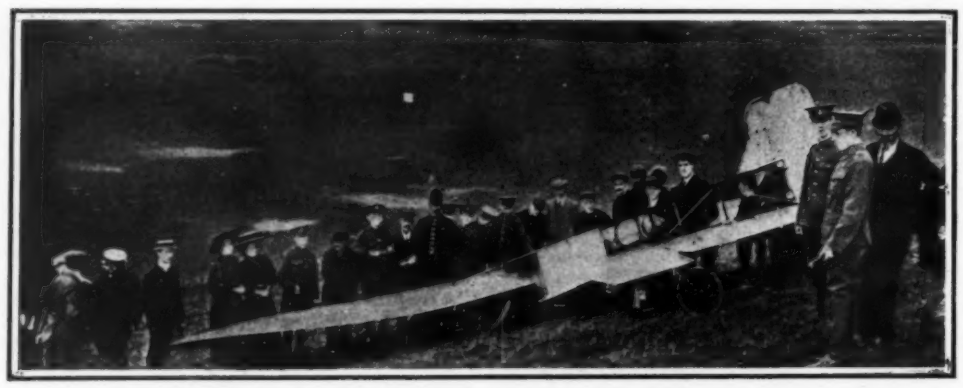
The Bleriot monoplanes, as constructed to-day, consist of two separate wings attached to a central body, the body being mounted in front upon a chassis which has two wheels wide apart, there being a third wheel at the rear of the body. The rear end of the body framework also carries a tail, consisting of a single transverse surface with movable tips on each end. These tips work together, and act as a horizontal rudder to steer the machine upward or downward when in flight. The No. XI. monoplane has a spread of 8.6 meters (28.2 feet). The width of the wings from front to back is about 5 1/3 feet, and the supporting surface has been reduced from 15 to 14 square meters (150.69 square feet). The total weight is but 320 kilogrammes (705½ pounds), including the aviator and fuel and oil for a two-hour flight. There is a 3-cylinder air-cooled motor of about 20 horse-power placed at the front end of the body framework, and carrying on its crankshaft a two-bladed propeller 2.1 meters (6.88 feet) in diameter. The weight of the motor is 65 kilogrammes (143.3 pounds), and the propeller develops a thrust of over 200 pounds, its speed of revolution being about 1,250 R. P. M.

A glance at the various diagrams will show the reader the different parts of the apparatus and their general arrangement. The two wings, *AA'*, and the stationary tail, *B*, are shown mounted on the front and rear ends of the body framework, *C*. The motor is located at *M* and the gasoline tank at *R*, and the aviator's seat is located at *S*, with the control wheel immediately in front. The movable wing tips forming the horizontal rudder are shown at *DD'*. The chassis carrying the wheels is indicated by the letter *P*. The various dimensions are indicated in meters and fractions thereof on the diagrams.

On his earlier machines M. Bleriot used movable wing tips on the ends of the plane for maintaining the transverse stability, but on the No. XI. machine he has a system of warping somewhat similar to that used by the Wrights. In Fig. 3 the two wings *AA'* are shown mounted upon the body frame, *C*. These wings each contain two longitudinal girders *a b* running throughout their length, and which are attached to the body frame by means of hooks. By slipping out these wings, the machine can readily be taken apart. The wings are inclined slightly upward from the body framework. In the first models they were placed in the same horizontal plane, but in this case there was a vertical stabilizing plane above and in the axis of the body. By using a slight dihedral angle, this can be done away with.

The method of warping the wings is as follows: The longitudinal girders *a a'* (Fig. 3) are maintained in a fixed position by means of the steel ribbons *h*, *h'*, passing over the steel frame *k*. Other steel ribbons, *j*, *j'*, pass over similar steel tube braces below the body frame. The ends *r r'* of the girders *b b'* can be displaced in a vertical plane by means of wires *h h'* and *j j'*, similar to the steel ribbons, but passing over a pulley *p*. By tilting the universally-mounted steering column with the bell arrangement near its bottom to one side, the wire *j* (Fig. 2) can be drawn in the direction indicated by the arrow. As this wire is attached at *r* and as the wire *h* passes over the pulley *p*, the end of the girder *b'* lowers while turning in the direction *a'*, while the end *r* of the girder *b* is raised and turns in the direction *a*. The warping of the wings *AA* is thus obtained very readily in a somewhat different way than it is done by the Wrights. The single surface *B* is stationary, while the two movable ends *DD* work together about the same horizontal axis *O*. This horizontal rudder is also connected to the bell at the bottom of the steering post. By moving the post forward or backward, the horizontal rudder is turned so as to direct the machine upward or downward, while by turning the post to the right or left, the surface is warped in order to right the machine when it tips, or to aid in steering it around the turns. The vertical rudder at the rear end of the body frame is operated by pedals.

When wing tips are employed, the method of operating by the Bleriot control column is shown in Fig. 1. Here *b* is a lever keyed to the horizontal shaft which carries the tip *a'*. Wires from the ends of this lever run through pulleys to the bell, such wires being indicated by 2 and 5. There are similar connections for the other wing tip. When the bell is rocked to one side or the other, the wing tips are set accordingly, and when it is pushed forward or pulled backward, the horizontal rudder tips on the ends of the tail are worked to direct the machine downward or upward. The same control column is used in all Bleriot's recent machines. This is one of the sim-



THE MONOPLANE AS IT ALIGHTED AFTER ITS TRIP ACROSS THE ENGLISH CHANNEL.

The front chassis was broke : by the sudden descent, as can be seen from the wheel beneath the wing.

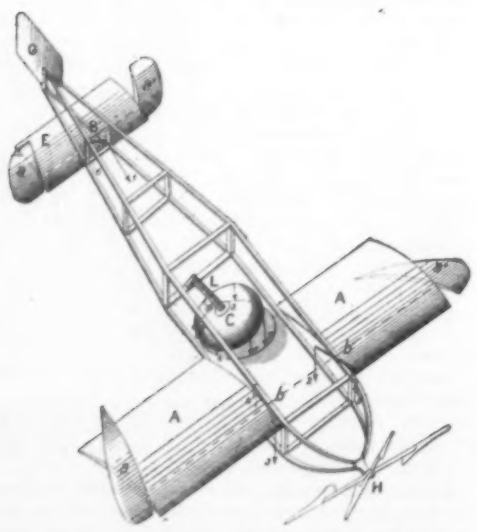


FIG. 1.—PLAN VIEW OF MONOPLANE, SHOWING UNIVERSALLY MOUNTED STEERING POST AND CONNECTIONS FOR WORKING WING TIPS.

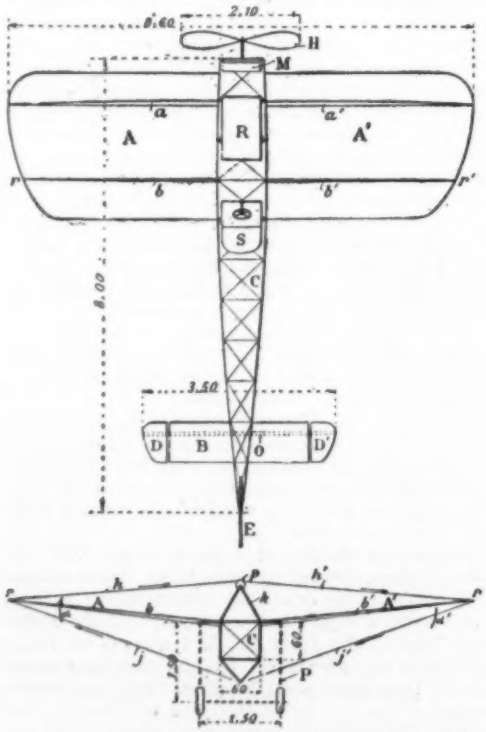


FIG. 2.—PLAN AND FRONT ELEVATION OF BLERIOT XI. MONOPLANE.

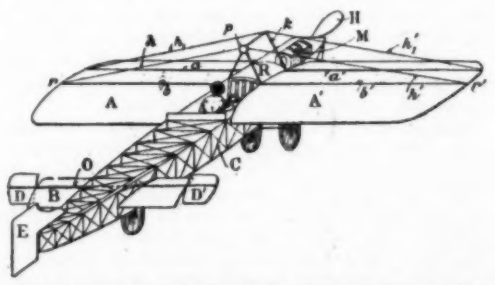


FIG. 3.—REAR PERSPECTIVE DIAGRAM OF BLERIOT XI. MONOPLANE.

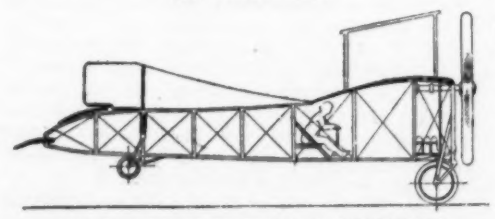


FIG. 4.—SIDE ELEVATION OF BLERIOT XII. MONOPLANE.

DIAGRAMS SHOWING MAIN FEATURES OF BLERIOT'S MONOPLANES.

piest controls, and one of the easiest to operate, that have thus far been devised.

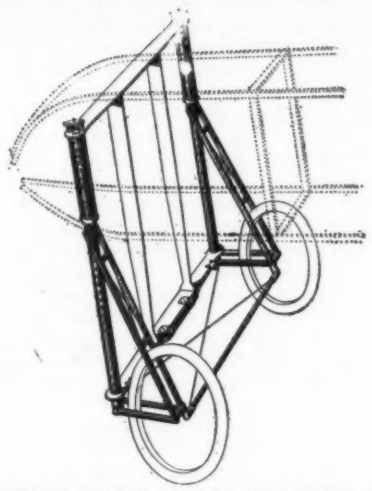
Fig. 4 shows a side elevation of Bleriot's No. XII. monoplane. This machine has the motor mounted at the bottom of the body, in order to obtain a low center of gravity. The shaft of the propeller is placed just beneath the plane, and is chain-driven from the motor. The vertical rudder is located above the rear wheel, and at the end of a fin keel above the body. The horizontal rudder is at the extreme rear end, and there is also a horizontal non-movable tail above the rear part of the body. This machine is provided with a deeply-curved monoplane surface having a lifting power of over 5 pounds per square foot at a speed of 32 miles an hour. Photographs of it and of the No. XI. in flight were published in the SCIENTIFIC AMERICAN of June 26th and August 7th and 14th.

From the above it can be seen that the latest Bleriot monoplanes are notable for their extreme simplicity, their good stability, and their excellent lifting power. These machines give a good indication of the lines along which development may be expected in the future in the way of a simple and compact aeroplane.

THE SENSE OF DIRECTION IN BEES.

By GASTON BONNIER.

IT has long been known that a worker bee returns in a straight line to the hive when she has finished her collection, even if the distance is as much as two miles. Langstroth and other eminent apiculturists attribute this power to the perfection of the compound eye of the bees, which enables them to recognize objects at great distances. Others conjecture that the bees returning to the hive recognize objects which they have noted on the outward journey. Still others think that both on the outward and homeward journeys the bees are guided by a very powerful sense of smell which is located in their antennæ. Dadant



FORWARD CHASSIS OF BLERIOT MONOPLANE.
The braces from the wheels are connected to spring shock absorbers in the vertical tubes.

asserts that all bee keepers believe that bees are attracted by the odor of flowers more than a mile away.

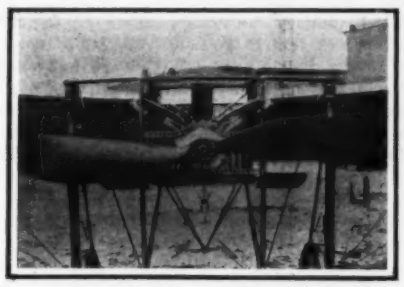
Varied experiments, which I have made or repeated recently, prove very clearly that it is neither by sight nor by scent that bees are guided in their direct flight over distances which may attain one and one-half miles, both in leaving and in returning to the hive.

In the first place, in regard to sight. I have repeated with several variations the experiment made by the American Indians when seeking for wild honey. They catch a few bees which are feeding on flowers, set them free, and note the direction of their flight; then they move to another spot and repeat the operation. The hive is found at the intersection of the two lines of flight thus determined.

This experiment does not solve the problem, but shows merely that when bees are disturbed in their work they return to the hive in a straight line. I have varied the experiment as follows: I collect a number of bees in a large district where I know there is only one hive. I place these bees in a closed box, where I can liberate them one at a time, and carry the box to a considerable distance, remaining on the circumference of a circle described around the hive with a radius of 1¼ miles. At a certain spot I liberate one of the bees. I note the place of liberation and the direction of flight. I go on a little farther, and liberate a second bee, making the same notes. The hive is found at the intersection of the two lines of flight. Now, both of these bees were shut up in the box during their journey to points distant from the place where they were caught. They could not recognize their course by means of the objects which they had seen in coming from the hive by a different road, and even if we admit that their eyes are marvelously long-sighted they cannot see the hive through intervening trees, woods and hills.

In a variation of the experiment blackened collodion is brushed over the two compound eyes of the bee and, as an extra precaution, over the three small simple eyes. Bees thus blinded return in straight lines to their hive, as before. These facts prove that sight is not necessary for a direct return to the hive.

Let us now examine the sense localized in the antennæ, which is more or less comparable with the



FRONT VIEW, SHOWING MOTOR, PROPELLER, AND CHASSIS.

sense of smell. In the first place, we may repeat the classical experiment of Lefebvre, which shows that the odors of various substances are not perceived by bees at any great distance. A needle which has been dipped into ether is brought near the head of a bee which is feeding on a drop of syrup. The insect at once directs its antennæ toward the needle and exhibits symptoms of great excitement. The experiment is then varied by bringing the needle wet with ether near the abdomen, the breathing pores, the feet and other parts. No special movement of the antennæ and no agitation of the insect are observed. The needle may be dipped into various odorous substances with the same result. In certain cases bees are repelled by perfumes which are agreeable to us and appear to detect odors of substances which we regard as odorless, but despite this delicacy of the sense of smell, odors are perceived only at a small distance. Now, what will happen if the olfactory organs are removed? Francis Huber was the first to prove that if a bee engaged in gathering honey is deprived of its antennæ it remains able to return to its hive, from which, however, it is afterward expelled as unfit for work. These facts suffice to prove that the sense of smell is not necessary for the return of bees to the hive.

The following experiments, which I have recently made, show that bees can almost always follow a definite direction without error, and distinguish between two directions which include a very acute angle. About 200 yards from the hive, in an open field, I place on a table a cluster of dead branches covered with syrup. On the following morning the exploring bees, which leave the hive at dawn, earlier than the workers, discover this new source of honey and organize a regular traffic of workers between the hive and the table. The supply of syrup is maintained by frequent renewal, and I catch every bee and mark it with talc, mixed with a green pigment. In the evening I place a second table with twigs and syrup about two yards away from the first. On the following morning the explorers discover the second table, and organize a regular traffic between it and the hive, but the traffic on the two routes is conducted by different bees. None of the marked ones comes to the second table, but the workers which visit the first table may be recognized by the green marks applied on the preceding day. I keep up the supply of syrup at both tables, and mark with red the bees which visit the second. With rare exceptions the green-marked bees continue to come to the first table, and the red-marked bees to the second table. This experiment proves that the bees are capable of discriminating between two directions inclined to each other at a very acute angle. In this case the angle is that at the apex of an isosceles triangle with a base of two yards and a height of about 200 yards. If the experiment is varied by placing the tables 20 yards apart, the few exceptions above noted do not occur. The two systems of traffic are entirely independent. If, then, the tables are brought back to their former positions, most of the green-marked bees still visit the first table and most of the red-marked bees visit the second, but there is a considerable mixing of bees at each table.

ARRIVAL OF BLERIOT ABOVE THE ENGLISH COAST AFTER HIS 37-MINUTE FLIGHT ACROSS THE ENGLISH CHANNEL.

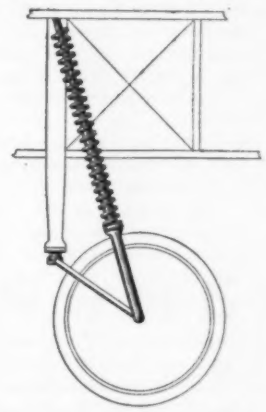
M. LOUIS BLERIOT AND HIS AEROPLANES.

Certain facts well known to bee keepers may be explained by the sense of direction. If a hive is moved a few yards, the workers returning from the harvest are unable to find it, and settle on its former site, even if this is occupied by a new platform, or basket, destitute of the odor of the hive. The eyes and the antennæ of the bees do not enable them to recognize their home, although it is only a few yards away. The habit of returning to a given point sometimes persists for a long time, as is shown by the following experiment of Huber, which has since been often repeated. In autumn honey was placed on a window sill, but during the winter access to the honey was prevented by the closing of a shutter. When the shutter was opened in the following spring the bees returned, although the honey had been removed. In this case the impression was retained for several months. From all the preceding facts I conclude that bees possess a special sense of direction, similar to that of homing pigeons. This sense does not appear to be located in the antennæ, but probably resides in the cerebral ganglia.—Cosmos.

REMEDIES FOR OLD AGE.

By DR. L. MENARD.

EVERY living creature, on arriving at the age of maturity, begins to grow old. In the human species



REAR WHEEL WITH SHOCK-ABSORBING SPRING.

the burden of age is felt more or less heavily by different individuals. It is a matter of heredity and hygiene. Some persons become old prematurely, but every person is old when a certain age is reached. Old age, or senility, is a physiological condition. It seems that if we could discover the mechanism of senility we ought to be able to delay its approach and to remain young despite the number of our years. The alchemists sought the solution of this problem, which still engages the attention of scientific men. The ancients thought that an old man could be reinvigorated by infusing into his veins the blood of a young man. They made the experiment, but, it is unnecessary to say, without success. The antiquity of the process of transfusion of blood is shown by passages from ancient authors. Allusion is made to it in the historical writings of the ancient Egyptians and in the treatise of anatomy written by Herophilus. A passage in Ovid, also, appears to refer to it. Sismondi relates that the experiment was tried on Pope Innocent VIII., and a contemporary writer says that in this case a certain Jewish doctor opened the veins of three boys, all of whom immediately died, and that the doctor fled and the Pope was not cured. It was thought possible to restore youth to the old, health to the ill, and reason to the insane, by this operation which, in France, was so greatly abused that the practice was forbidden by law. It has lately been taken up again, but for a very different purpose, to avert the danger arising from profuse hemorrhage.

Transfusion of blood cannot remove the effects of the old age of the organs. A living creature extracts from the surrounding medium the matter necessary for the performance of its vital functions. It transforms this matter, assimilates the useful portion and rejects the useless portion, as well as the waste products of its metabolism. In a culture of bacteria, these waste products accumulate and produce symp-

toms of senility in the microbes. If a few of these bacteria are transferred to fresh bouillon they acquire renewed activity and become young again. In more complex organisms life consists essentially of similar physical and chemical changes performed with more elaborate organs of co-ordination and elimination. The used-up material, more or less completely oxidized, is eliminated by the natural emunctories. When the activity of the organ is reduced, so that the elimination is not sufficiently rapid, a sensation of fatigue and a need of rest and sleep are experienced. During rest and sleep the chemical transformations are retarded, the waste products are eliminated, and the sensation of fatigue disappears. But there are insoluble substances of bony and cartilaginous nature which are continually formed in the processes of life and which are imperfectly or not at all eliminated during sleep. These products accumulate in the system and produce the phenomena of old age. As Le Dantec, the author of this hypothesis, observed, the muscles of old animals are much tougher than those of young ones, owing to the accumulation of cartilage, but, in general, it is not the accumulation in the muscles that is most injurious. The accumulation of these substances in the walls of the blood vessels is more dangerous because the vessels are thus made more brittle and liable to rupture. A man is as old as his arteries. When the condition of senility has thus been produced, the person is more likely to become a victim of various accidents. The predominance of the sclerous elements, which stifle the active organic cells, is favored by a process which has been studied by Metchnikoff. The cells called macrophages devour the noble cells, as weeds encumber and choke the good grain. Hence, the idea of a cytolytic serum, which will destroy the macrophages. Le Dantec suggests, however, that if the noble cells allow themselves to be devoured, it is because they are weakened. It is necessary, then, to prevent their growing old or to restore them to the condition which they had in youth, when they were invulnerable to the attacks of the devouring cells. Alcoholism and various infectious diseases hasten this weakening process, this senility of the cells, which invites attack by the macrophages.

Another cause of senility is found in the formation and retention of bacterial poisons in the large intestine. Hence the utility of purgatives which remove these poisons, and of a milk and vegetable diet, which diminishes their production. Hence, also the utility of certain fermentation products of milk, especially yoghurt, the bacillus of which effectively combats the poison-engendering microbes of the colon. Again, many of the poisons produced in the organism are eliminated by the kidneys. A man may be said to be as old as his kidneys. Hence, an old man who feels the premonitory symptoms of uremia might borrow a kidney instead of blood from a young man. Dr. Carrel, a French physician residing in America, has succeeded in transplanting the kidneys of an animal to another animal of the same species, which survived the operation. It is not impossible in theory that the same experiment would succeed in the human species. Let us admit, therefore, that the kidneys of a young man, who has been condemned to death or suffered death by accident, could be transplanted to an old man. Even if the operation succeeded, the old man would be only slightly rejuvenated, for his brain, his liver, and his other organs would remain hardened and old. He would still be as old as his arteries. We must be content to grow old. The ravages of years remain as irreparable in the twentieth century as they were in the time of Solomon.—Cosmos.

PALÆOLITHIC MAN.*

HIS PRESENT SCIENTIFIC STATUS.

RECENT discoveries have filled up to a great extent the gaps in our knowledge of Palæolithic man. The skeleton find in the lower grotto of Le Moustier (Dordogne) in the main confirms Klaatsch's conclusions, based on a comparison of the face-skeleton of the Neanderthal race with that of the present Australians. *Homo mousteriensis* belongs to the older Diluvial race; that is, to the Neanderthal type, not to *Homo sapiens* found in more recent Diluvium. The subject was about sixteen years old, probably a male. That *Homo mousteriensis* belongs to the Neanderthal type is further shown by the character of the femur and radius (of which the length is estimated at 195 millimeters, while the upper arm measures 210 millimeters). The Neanderthal race had short extremities, in which fact Klaatsch sees an approximation to the present Arctic races of Mongoloid relationship.

Mention must also be made of the extraordinarily massive proportions of the absolutely chinless lower jaw. The knobs on the backs of the incisors recall the Krapina find. All the upper front teeth have much curved roots adapted to the round arching of the upper jaw-bone.

The position of the skeleton at Le Moustier, like that of the find at Grimaldi, proved that Diluvial man buried his dead with care. The posture is that of sleep, with the face turned to the right, and the right arm under the head, which was surrounded by flint flakes. Beside the skeleton were found, in addition to flint implements of the Mousterian type, some of the Acheulean type, among them a splendidly worked "hand-wedge." A mark on the right femur is traceable to burning, but there is no sign of the cannibalism ascribed by Kramberger to Krapina man.

Another important find in France is that of a male skeleton, brought to light by the Abbés A. and J. Bouyssonie and Bardon near La Chapelle-aux-Saints (Corrèze), in an absolutely undisturbed archæological stratum. The subject is an old man of about 1.60 meters in height. The skull is actually 208 millimeters long by 156 millimeters broad; that is to say, dolichocephalic, with an index of 75. The height from basion to bregma is only 116 millimeters. The breadth-height index is 62, far outside the variation in living man. The huge, almost round orbits and very wide nasal aperture agree with what has been noted as very remarkable in skulls of the Neanderthal type. Though the face is defective, its prognathous nature is clear. The mandible is of great dimensions, and in so far as senile atrophy has not produced changes, exhibits a formation which agrees in the main with those of lower jaws from Spy, Krapina, La Naulette, etc. Here, too, we have absence of chin, "negative chin-formation" (Klaatsch). The occipital and temporal regions have Neanderthal characteristics. The old man's grave contained no tools of the Acheulean stage. This fact, and the predominance of reindeer-bones in the grave, would lend some degree of probability to the supposition that La Chapelle man belongs to a rather later cultural phase than Le Moustier man. Both are to be taken as representatives of the Neanderthal type, and as belonging to the Middle Diluvium.

P. Adloff has in several publications dealt with the question as to whether the above physical characteristics comprised under the term "Neanderthal race" represent an absolutely fixed human type, or whether they were subject to variations. As regards differences of dentition in different specimens of the Neanderthal type, he comes to the conclusion that by no means insignificant differences do exist; Krapina man especially exhibits a form sharply distinguished from other representatives of the genus Homo. Obviously, in a type like the Neanderthal, scattered over a vast area, and doubtless existing for many thousands of years, certain variations must arise by way of adjustment to different climatic conditions, food, mode of life, etc.

Dr. O. Schoetensack has recently made a notable find at Mauer, near Heidelberg, of a fossil human lower jaw, which he has called *Homo heidelbergensis*. It unites two at first seemingly contradictory qualities: (1) massiveness of the body of the jaw, combined with entire absence of chin-projection, breadth and thickness, and special form of the ascending rami—phenomena usually taken as indicating a development little advanced, so-called pithecoid qualities; (2) a set of teeth agreeing with that of present man in all essentials, the size of the teeth not surpassing the scale of variation in some still extant primitive peoples (e. g., Australians). No doubt, as Adloff says, the teeth of man are in many respects more primitive than those of anthropoids, and the pithecoid characteristics met with in human dentition are actually primitive features. A glance at the lower jaw of a young gorilla or of a South American howler shows a remarkable resemblance of the mandible to that of *Homo heidelbergensis*. Dr. W. Wright has given an account and illustrations of this jaw in Nature of June 3rd, p. 398.

In determining the exact position of *Homo heidelbergensis* in the human pedigree, it must always be borne in mind that a huge difference in time exists between *H. heidelbergensis* and the members of the Neanderthal race. Fossil remains of Neanderthal man belong to the Middle Diluvium, coinciding in general with the Mousterian culture period; whereas the remains (of *Elephas antiquus*, *Rhinoceros etruscus*, Falc., and *Equus stenonis*, Cocchi) were found undisturbed in the same stratification with *H. heidelbergensis*, which points to earliest Diluvium or to the transition period from Diluvium to late Tertiary age (Pliocene). The long periods intervening between Neanderthal man and *H. heidelbergensis* are shown by Penck's climatic curve of the Glacial periods (Ice ages), mainly coinciding with the Quaternary age, with warmer inter-Glacial periods between and the Palæolithic culture periods introduced into his diagram. The culture epoch, called Mousterian by the French prehistorians, corresponds, according to Penck, together with the subsequent divisions of Palæolithic culture (Solutrean, and perhaps partly Magdalenian), to the Ice-age divisions, comprising the inter-Glacial epoch, which falls between the Riss and Würmeiszeit. On the other hand, Penck makes the oldest divisions of Palæolithicum correspond: Acheulean and the preceding Chellean, to the warm intervening epoch of specially long duration between the Mindel and Risseiszeit. Obviously, the late Palæolithic age (of successive Mousterian, Solutrean, and Magdalenian cultures) lies very much nearer to the present than that earlier division of the Palæolithic age (of Acheulean and Chellean cultures).

The supposition that a very long interval elapsed between Middle Diluvium (with Neanderthal man in Europe) and that earliest Diluvium (of *H. heidelbergensis*) receives indirect confirmation from recent excavations by R. R. Schmidt (Tübingen). He devotes himself chiefly to later divisions of the Palæolithic age, and, working back from the Neolithic age, shows the relatively long duration of the culture-sections which he calls late, high, and early Magdalenian; later and earlier Solutrean; late, high, and early Aurignacian; and late Mousterian. However, the slow and gradual earliest cultural progress of the human race leads one to attribute to those oldest divisions of the Palæolithic age, commonly called Chellean or Acheulean, a still longer duration than to all those later divisions.

Thus an enormously long period must have elapsed between Neanderthal man (generally coinciding with Le Moustier culture) and *H. heidelbergensis* (of earliest Diluvium, or Pliocene-Diluvium transition). No fundamental objection stands against the view of Rutot, Klaatsch, Verworn, and others that the first beginnings of human cultural development reach far back beyond Diluvium into the middle division of the Tertiary period (Oligocene, according to Rutot), and that the much debated eolith is to be regarded as the primitive implement of man at the lowest cultural stage. It is obvious that an extremely long period of slow development must have preceded the production of the "hand-wedge," the characteristic implement of the Chellean age.

Neanderthal man, then, is of slight antiquity as compared with *H. heidelbergensis*. Klaatsch has for years upheld the theory that to discover the roots of the human race we must go very far back, perhaps even to the roots of the mammalian genealogical tree, and additional probability is lent to this idea by the Heidelberg find. The teeth of the Heidelberg jaw undoubtedly prove that no anthropoid stage preceded that to which the Heidelberg mandible belongs, so that to explain the similarity of human and anthropoid forms we must go back to the remote ancestor from which there branched off on the one side the genus Homo and on the other the genera of anthropoids and perhaps of other ape-species. The fact that the origin and development of anthropoids reaches back to the Middle Tertiary age (Miocene) prevents the assumption that the Heidelberg mandible is itself the stage of development at which the anthropoids branched off from the genus Homo; this is also rendered improbable by the discovery of eoliths in Middle Tertiary beds. There is nothing to preclude the supposition that the Heidelberg fossil, as regards formation, stood fairly near the point of separation. The line of descent Pithecanthropus—Neanderthal man—recent man has to a certain extent been shaken by the recent researches, which attribute less antiquity to Pithecanthropus than was hitherto supposed to be the case.

At the conclusion of the paper is a brief discussion of the genealogical tree of the phylogeny of man and the anthropoids, recently published by Prof. G. Bonarelli, of Perugia. According to this table *Pithecanthropus erectus*, *Homo heidelbergensis*, and Neanderthal man may be regarded either as successive stages in the direct line of descent of Hominidæ or as offshoots from those stages.—A. C. Haddon in Nature.

* "Recently Discovered Fossil Human Remains and Their Bearing upon the History of the Human Race," by Moritz Alsberg (Globus, vol. xcv., No. 17, May 6, 1909).

ATMOSPHERIC CIRCULATION.*

HOW CYCLONES AND ANTI-CYCLONES ARE FORMED.

BY R. F. STUPART.

THE astronomer Halley in 1686 enunciated the theory that as the temperature of the air decreases from the equator to the poles, there ought to constantly exist an upper wind or equatorial current blowing from the equator to the poles, and a lower wind or polar current blowing from the poles to the equator. This theory was supplemented by Halley in 1735 by the statement that whatever be the direction followed by an atmospheric current, the earth's rotation deviates this current to the right in the northern hemisphere and to the left in the southern hemisphere.

Halley's theory seemed reasonable, but as observation showed that the general drift of the atmosphere in the middle and higher latitudes is from the westward, it became necessary for the more modern meteorologist to find directly what are the true movements of the atmospheric currents and then formulate a theory in accord with ascertained facts.

The earliest data available regarding the circulation of the upper air, based on cloud movements, was provided by many keen observers, among whom the Rev. Clement Ley of England and Prof. H. Hildebrandsson of Sweden stand pre-eminent. Further and still more conclusive data as to atmospheric movements have been obtained within the past few years by means of kite and balloon, and among the most energetic investigators were Prof. A. Lawrence Rotch of Boston, Mass., and M. Teisserenc de Bort of Paris, France.

In a zone near the equator—a zone encircling the globe, and comprising the region of highest temperature, and which oscillates northward and southward, moving always with the sun—observations show that the atmospheric currents at every height, and almost without exception, are from east to west.

North and south of this equatorial zone, approximately to latitude 35 deg., are found the steady persistent northeast and southeast trade winds, the prime factor in producing the great ocean currents, and above these trade winds there prevails an anti-trade from the southwest in the northern hemisphere, and from the northwest in the southern. Beyond the trade-wind zones, over the middle latitudes, the prevailing drift of the atmosphere is from west to east, and with this atmospheric drift move the cyclonic areas which lead to the summer shower as well as to storm and rain and snow. Charts of barometric pressure indicate that the whole wind system of lower latitudes is directly connected with pressure conditions, there being a belt of low barometer readings around the globe in the equatorial zone, and belts of high barometer readings to the northward and southward, the whole system having an annual oscillation with the changing declination of the sun.

The tropical belts of high pressure have sometimes been explained as a result of the crowding of the upper currents from the equator advancing along the converging meridians, but this can only be in part correct, for if the convergence of the meridians determined an increase of pressure, the pressure should be highest at the poles, whereas it is highest between latitudes 30 and 40.

Observation has shown pretty conclusively that the equatorial currents in the upper regions turn away to the eastward in the direction of the earth's rotation and form a continuous whirl around the earth over all the higher latitudes, and it is now believed that the high pressure which should result from the low polar temperature and the shape of the earth, is reversed into low pressure by the forces which lead to the circumpolar whirl, and the air thus held away from the polar regions is found in the tropical belts of high pressure.

The distribution of continent and ocean tends toward complexity. As land absorbs the solar heat much more rapidly than does the ocean, and, conversely, parts with heat more readily, the range of temperature between summer and winter of continental areas is vastly greater than over the ocean, and the circulation of the atmosphere near the earth's surface is in consequence greatly modified by land and sea.

The most marked evidence of this is found in southern Asia, where with great heat in summer is situated the lowest barometric pressure of the northern hemisphere, which leads to the southwest monsoon of the Indian Ocean, and which is indeed the southeast trade wind deflected to the southwest after passing to the northward of the equator. In winter, on the other hand, over the great land area of Asia is found a vast anticyclonic system which may perhaps not unreasonably be regarded as a portion of the extra-tropical pressure drawn northward and intensified by the contraction of the atmosphere owing to low temperature, and leads to the northeast monsoons of the Indian Ocean and China Sea, which are closely related to the northeast trade winds of Atlantic and Pacific.

It is clearly evident, however, that while the effect of continent and ocean is far-reaching, it is but one of several factors governing the atmospheric circulation. The fact that the highest winter barometric pressure in Asia is found far south of the greatest cold, together with the general appearance of the chart of mean pressure, suggest that the factors which lead in general to the extra-tropical belts of high pressure are predominant. In the southern hemisphere, with a vast preponderance in area of the ocean over land, the extra-tropical high-pressure belt is more continuous and persistent throughout the year, merely changing its position with much regularity with the changing declination of the sun.

As yet it is not known why the atmospheric circulation varies somewhat from year to year. It certainly does vary, and this variation may be sufficient to wholly account for the changeableness in the character of corresponding seasons in different years. Investigation of the solar radiation, together with barometric gradients and wind velocities in the tropics, may not prove abortive.

An interesting problem, now receiving attention in the Meteorological Office, is that of the formation of anticyclones in the higher latitudes. It seems not improbable that these anticyclones represent the coming to earth of branches of the great equatorial overflow, and it is important to investigate the connection between them and pressure changes and wind movements in the tropics.

* From the Journal of the Royal Astronomical Society of Canada.

NEW RADIOACTIVE PHENOMENA

THE RADIATION OF METALLIC PLATES BOMBARDED BY BETA RAYS.

M. DOBLER has investigated the relations existing between the velocity of the bombarding β rays, the thickness of the plate and the intensity of the induced radiation. The β rays were caused to move in the arc of a circle by subjecting them to the influence of a magnetic field. From the radius of the circle and the intensity of the field the velocity of the β particles can be computed by the usual formula, employing Kaufmann's value of the ratio of charge to mass. The

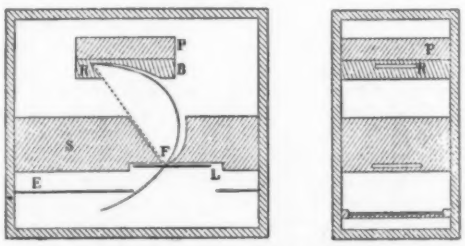


FIG. 1.—FIRST ARRANGEMENT.

R, tube containing radium bromide; P, B, S, leaden screws; F, slit; L, photographic plate; E, brass screen.

radius is known when three points of the circle have been determined. These three points are given by the radiant substance, a slit in a screen and the corresponding point of the photographic image.

The source of radiation was 15 or 20 milligrammes (about ¼ grain) of radium bromide. In the first series of experiments the photographic plate made an acute angle with the plane determined by the radioactive substance and the slit in the leaden screen (Fig. 1). In the second series the plate was perpendicular to this plane (Fig. 2). The electromagnet having been standardized, the intensity of the field could be calculated from the strength of the current as indicated by a galvanometer.

The magnetic field being established and the photographic plate exposed, the line of intersection of the plate with the plane of the source and slit is traced on the sensitive plate by the influence of the γ rays. Beyond this line extends the region affected by the β rays, the maximum effect being produced by the rays of medium velocity. Half of the sensitive plate is then covered with a thin plate of platinum. The effect is to intensify part of the image and to weaken the remainder. In one region the intensity remains unchanged because the secondary radiation from the platinum exactly balances its absorption of the primary rays.

M. Dobler studied the influence of the thickness of the platinum plate upon the velocity of the β rays and obtained a relation between the intensity of radiation, the thickness of the plate, and the velocity. Curves of equal velocity were plotted by employing the thickness of the plate as abscissa and the intensity of the photographic effect as ordinate. The results appear to be represented, to a first degree of approximation, by Paschen's formula which gives the intensity of the secondary radiation as a function of the thickness of the metallic plate.

Metals bombarded by Roentgen rays likewise emit secondary radiations composed of Roentgen and cathode rays. M. Dorn has measured the velocity of the cathode rays thus produced, on the assumption that the ratio of charge to mass, $\frac{e}{m}$, is the same as in other cases of radioactivity. The cathode rays were subjected to an electric field and a magnetic field so arranged as to cause deviation in opposite directions. It is easily proved that those electrons whose velocity is equal to $\frac{F}{H}$, the ratio between the intensities of the electric and magnetic fields, undergo no deviation. If the electric field is suppressed the rectilinear trajectory is converted into a spiral. M. Dorn thus finds a minimum velocity of 1.72×10^7 C. G. S., instead of the value 1.8×10^7 C. G. S. obtained by earlier experimenters.

The annual report of the National Physical Laboratory contains an interesting account of a series of experiments carried out by Mr. W. A. Price with a view to devising a satisfactory form of electric heating unit. The form finally adopted was to wind a thin strip of Eureka resistance material on a thin sheet of mica, the electrodes of copper strip being then threaded into

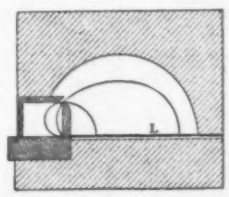


FIG. 2.—SECOND ARRANGEMENT.

the mica and hard soldered to the Eureka strip. A thin sheet of mica is laid on each side and sewn round the edges, and the whole is slipped into a thin copper envelope, which is let into and soldered to the lower side of the bath. This envelope being a nice fit round the mica, the unit can be easily removed for renewal or repair without moving or emptying the bath. Some of the units, it is stated, have been in use for several months for heating baths up to 100 deg. C. without a single case of breakdown. Each unit is made in two sections, each of which will take four amperes at 100 volts—i. e., a total of 800 watts per unit—and by means of switches they can be put in series, or singly, or in parallel, as occasion demands.

IMITATION ARMS AND ARMOR.*

HOW TO MAKE THEM AT HOME.

BY A. ROZE.

THERE must be many who have gazed upon genuine antique swords and armor, as used by the knights and soldiers in days of old, and wished to be the happy possessors of some of the same. Genuine armor, however, is a very expensive luxury, and at the present time by no means easy to obtain; but a study of the following article will explain how my readers may

FIG. 1. FIG. 2. FIG. 3. FIG. 4.

make their own at very little cost, and if carefully made, it will look very like the genuine article.

Few tools and materials will be required—namely, an ordinary saw, fretsaw, or the ordinary keyhole saw is just as useful; glue-pot and brush, several small wood-modeling tools, various shapes as used by sculptors and modelers in clay (these last can be procured from dealers in artists' materials), pieces of thin brown paper, strips of thin, untanned leather about 1 inch in width, fancy brass-headed nails as used by upholsterers, sheets of medium-grain glass-paper, and a few other items which will be given later on. The drawings illustrating this article are made so plain that the amateur armorer should have very little difficulty, if any, in building up his work from the illustrations, whether he requires a single sword only, or a complete suit of armor life-size.

The pieces or designs in this article are from authentic sources, so that where names are given the amateur armorer can so label them, and will thereby greatly add to their interest and value.

Fig. 1 is an executioner's sword of the fifteenth century; the blade should be about 27 inches in length; the handle or grip should be such a length as to allow the two hands to grasp it firmly; the width of the blade near the handle about 2½ inches, tapering down to 1½ inch near the point of the blade, with several lines running round the handle to permit of a firm grip; the cross-guard is flat, and about 1 inch in width.

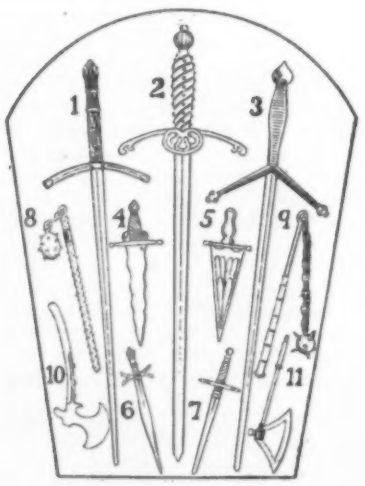


FIG. 5.

First mark out the shape and size of blade on a piece of wood, ⅛ inch thick, by the aid of a straight-edge and pencil, allowing a few inches more in length for insertion into handle; then cut out with the saw. Next, smooth surface both sides with glass-paper—the edges on both sides to be made thin by sharpening them with a vigorous use of coarse-grained glass-paper, finally finishing off with a finer grain. With care, the above work will put the blade into shape. The end which has to be inserted into the handle should be cut about 1 inch wide and 2 inches in length. The handle must next be carved, having a vertical hole bored with a hot iron, or cut with a center-bit, for the reception of the blade. Now, cut the cross-guard; in the center a hole must be cut to allow the blade to pass through, which finally rests in the handle. (If the armorer does not possess a lathe by which he can turn the shape of the handle, the lines running round can be imitated by gluing and tacking on circles of thin rope, such as used for clothes lines.) The cross-bar or guard can now be glued and placed upon the blade, then the hole in the handle filled with glue—not too thick, and quite hot. Now, the blade, with cross-bar, is to be inserted, and thus the whole made fast. When quite dry, paint the handle with oil paint (brown, dark red, or green). The all-important task is now the covering of the blade, to give it the appearance of steel, which can be done by covering it with tinfoil. The latter will form a very important part of the stock-in-trade wherever the object is supposed to be metal. Sheets of tinfoil can be procured from fancy-paper dealers or from dealers in wall papers, the average size being about 24 inches by 18 inches. Cut two strips of tinfoil for the blade, one ½ inch wider than the blade, the other ¼ inch narrower. Well paint the blade with thin glue quickly on one side, then evenly lay and press the narrow strip on. Then glue

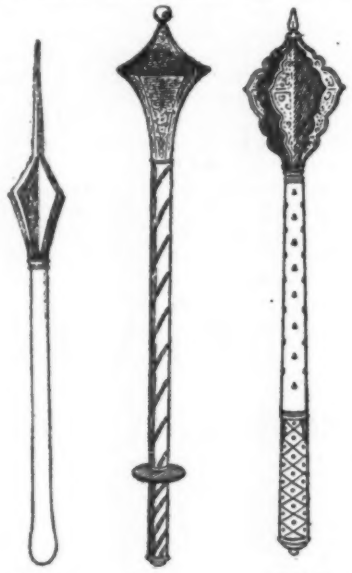


FIG. 6. FIG. 7. FIG. 8.

the wider strip on the other side, allowing an equal margin to overlap the edges of the blade. Glue the overlapping edge of the tinfoil and press it round and on to the surface of the narrow strip. The cross-guard must be covered with tinfoil in the same manner as the blade. When the whole is quite dry, gently wipe the blade up and down several times with a soft, dry piece of rag or duster. It is then ready to hang in its chosen place as a decoration, not for use except in cases of tableaux, for which this article will be especially useful to those who are arranging living pictures wherein swords and armor are part of the paraphernalia.

Fig. 2, a Chinese scimitar. The handle is oval, covered with a plaited cord, the pommel or guard metal, as also the blade and the top of the handle. In making this scimitar, follow the directions as for Fig. 1, except that the handle has to be covered with a round black cord, about the size of an ordinary bootlace. If it is found difficult to plait the cord on to the handle as in the illustration, wind it round in a continuous line closely together, and finish by fastening with a touch of glue and a small tack driven through cord into the wooden handle; the pommel to be a circular piece of wood ¼ inch thick and 5 inches diameter. The length of handle, allowing for a fair hold with both hands, should be about 9 inches; the length of blade 28 inches; the width near pommel 1½ inch, and the lower end three inches in the widest part; the sharp, or cutting, edge, only on one side, viz., the shorter edge of the blade, the other to be flat or half-round.

Fig. 3, a Turkish saber of ancient manufacture from Constantinople, the handle to be painted a dull, creamy white, in imitation of ivory. The enamel paint sold in small tins will answer admirably for this purpose, the cross-guard and blade steel to be built in the same

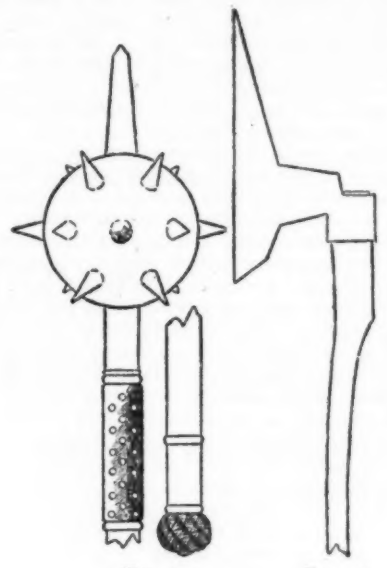


FIG. 9. FIG. 10.

manner as the foregoing swords. The sharp edge is on the longer curved side; the other edge flat or half-round.

Fig. 4, a two-handed sword, about 5 feet 8 inches in length, cross-guard and blade steel, handle wood painted black, the ball or pommel on top of handle to be steel: handle is round. Both edges of blade sharp. Period between the fourteenth and fifteenth centuries. If several swords, battle-axes, etc., are made, and then mounted on a wooden shield which has previously been covered with a dark red or green cloth or baize, they will have a very charming and decorative effect. The swords can be held in position on shield by pieces of copper wire, a small hole being made through shield on each side of the weapon with a bradawl, through which the ends of the wire are passed, and then twisted together at back of shield.

Fig. 5 shows a shield, decorated and ready to hang high up on the wall of room or hall. The swords, etc., shown on this design can be used as pattern to work from. The sword on left of shield No. 1 is a German sword of the fifteenth century, 4 feet in length, steel blade and cross-guard. The handle is copper. The ornament can be built up of wire, string, thin rope, and small round-headed nails, the whole finally having a thin coating of glue worked over it with a hog-hair brush and finished with a coat of bronze paint to imitate copper; the bronze paint can be procured from fancy shops, ironmongers, or oilmen. Both edges of the blade are sharp.

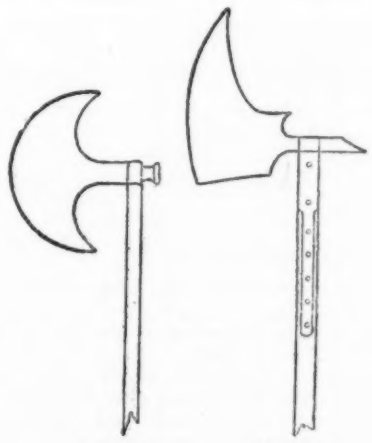


FIG. 11. FIG. 12.

The sword in the center, No. 2, is a two-handed Swiss sword, about 4 feet in length, sharp both edges, the handle dark wood, on which wind stout brass or copper wire, which can be held in place by round-headed brass nails; the blade and cross-bar steel. The projecting ornament in the center of the cross-guard may

* English Mechanic and World of Science.

be cut from stout millboard and bent into shape, then glued on the sword on the right.

No. 3 is a Claymore, or Scottish sword, of the fifteenth century, about 4 feet in length; wooden handle, bound closely round with thick cord; cross-bar and

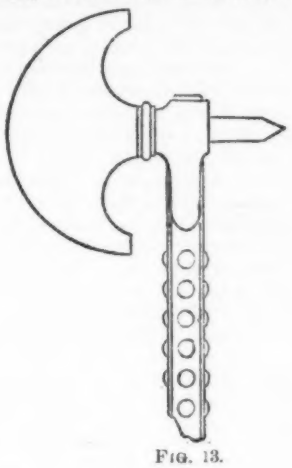


FIG. 13.

blade steel, both edges sharp. The top weapon, No. 4, between the left and center sword, is a German poniard, about 1 foot in length, very broad, with wire or string-bound handle, sharp edge both sides. The weapon on the right, No. 5, is a poniard, date end of the fourteenth century, about 1 foot in length, wooden handle, steel-embossed blade.

length. These must be carved from pieces of wood, leaving a small peg at the end and in the center, about the size of a slate pencil; the pegs to be well glued and inserted into holes already drilled in the ball for their reception.

No. 10, Sclavonic horseman's battle-ax, the handle of wood painted a dark gray or light brown; the ax steel. The blade can be made of cardboard; but a better appearance and effect will be given if it is cut cut of a piece of wood, about ¼ inch thick, by the aid of a keyhole or fret-saw; the round edge of ax to be made thin or sharp by the use of glass-paper. The thick, hammer side of the ax can be built up to the necessary thickness to cover the handle by gluing on pieces of wood the same thickness as used for the blade, and gradually shaping off to the middle of ax by the use of a chisel, and finishing with coarse glass-paper, then covering with tinfoil. Three large, round-headed brass or iron nails fixed into the front side of the handles will complete it.

No. 11 is a horseman's battle-ax, beginning of the sixteenth century, handle and ax of steel. This ax to be made in accordance to instructions for No. 10, and when the woodwork is finished the handle and ax to be covered with tinfoil.

Fig. 6 shows an English mace, about the middle of the fifteenth century, the entire length about 24 inches, round handle. At the top are six angle-shaped wings, placed at equal distances one from the other, the whole surmounted by a four-sided sharp spike. Carve the handle and spike in one piece, then glue the wings on. The two bands, or rings, immediately under the wings, if difficult to carve properly on the handle, may be made by gluing two pieces of rope round and firmly

wooden peg about 2 inches long and the thickness of a pencil fixed into one of the ends, a hole being made in the other part of the handle to receive the peg. When all is ready, well glue the peg, over it place the circular shield, then insert peg into the other part of

FIG. 16.

the handle. The shield can be cut from a piece of wood about a quarter of an inch thick, marking a circle first with a pair of compasses; the head can be fixed into position also by the use of a peg. The octagonal head must have a pattern sketched upon it in pencil, such as ornamental scrolls, leaves, flowers, etc.

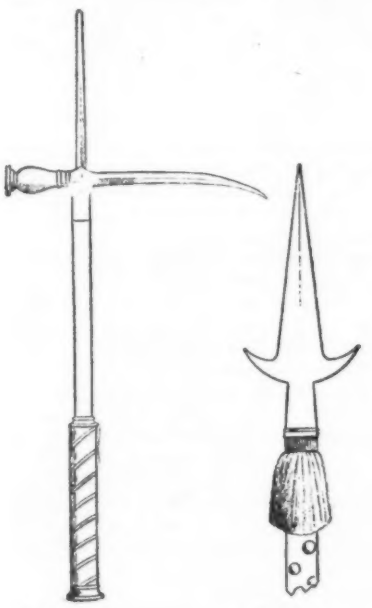


FIG. 14.

FIG. 15.

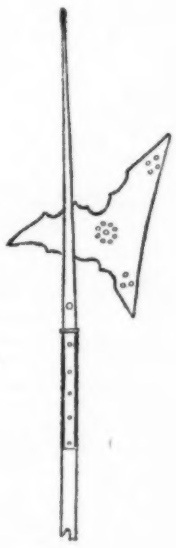


FIG. 17.

FIG. 18.

FIG. 19.

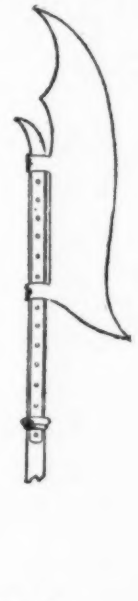


FIG. 20.

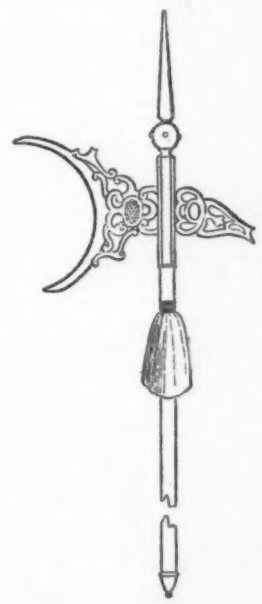


FIG. 21.

No. 6, a German poniard, sixteenth century, wooden handle; blade and ornamental cross-bar steel, both edges sharp.

No. 7, a German stiletto, about 12 inches long, sometimes called cuirass-breakers; wooden handle, steel cross-bar, and blade steel, both edges sharp.

No. 8 is a short-handed flail, about 2 feet 6 inches in length, dark wooden handle, studded with brass or steel nails; steel band round the handle near the top; this is imitated by a piece of tinfoil glued on a strip of cardboard and nailed on handle with two or three tin tacks. A large iron screw-eye to be screwed into top of the handle; a thin piece of cane or rope can then be twisted into shape and secured to screw-eye, finishing by covering with tinfoil. The spiked ball may be made of wood or clay, worked into the shape if the latter is used. Cover with some pieces of linen firmly glued on. When dry, paint it a dark brown or black. A large screw-eye must be inserted into this ball, the same as used for the top of the handle, so that it may be attached to the latter, as seen in the drawing. Finally, some short, stout spike-headed nails must be driven into the ball to give it the finishing touch.

No. 9, a Russian knout. The lower half of handle is wood, the upper part iron or steel, which can be imitated by covering a piece of wood that is properly shaped, with the ring at the top, and then covering with tinfoil. It will be found the easier and better way to make the handle in one piece, painting the lower half black and then tinfoiling the upper end. A length of real iron chain will greatly add to the effect of this weapon; the chain can be purchased at most ironmongers, or can be constructed of pieces of cane, and then covered with tinfoil; but unless this is very carefully and well done, it will not look well, nor have a realistic effect. The ball to be made of wood or clay, as described for No. 8, with a large screw-eye in it; the spikes in ball to be about 1 inch in

fixing with small tacks or gimp-pins. When the whole is dry cover with tinfoil.

Fig. 7 is an engraved iron mace, about 22 inches long, fifteenth century period, surmounted with an eight-sided or octagonal head. It will be found the

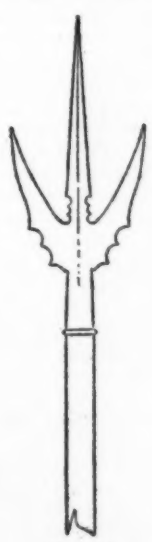


FIG. 23.

FIG. 28.

easiest method to carve this mace in three pieces, the octagonal head in one piece, and the handle in two parts, so that the circular piece shown at the lower end of the handle, and which occupies a horizontal position, can easily be placed there, it having a hole in its center to receive the handle, which must have a

it may be then cut into about a quarter of an inch in depth by the aid of a sharp wood-carving tool. If such a tool is not at hand, or the amateur armorer cannot use it sufficiently well, an excellent substitute will be found in a sharp-pointed red-hot poker, or pieces of stout iron wire heated, when the pattern can be followed and burnt out. The handle has also a scroll running round it to be engraved. When the whole is finished, cover with tinfoil, carefully and firmly pressing it into the engraved parts with the finger-tips or thumb.

Fig. 8, French mace, sixteenth century. The handle wood covered with dark red cloth or velvet, the lower part of handle to have a gold or red silk cord wound round it, as shown, and the whole handle finished off with small brass-headed nails. The top of the mace is metal engraved; it has six ornamental wings. The description given for building up Fig. 7 will answer for this.

Fig. 9 shows a Hand morning star, about 26 inches long. The spiked ball and the four-sided spike surmounting it is steel; steel handle, covered in the middle with red cloth or velvet, and studded with nails. This weapon to be constructed of the same materials, and built up in the same way as the foregoing.

Fig. 10 is a horseman's short-handled battle-ax, end of the fifteenth century. Handle is wood, the ax steel.

Fig. 11, English horseman's battle-ax, beginning of Queen Elizabeth's reign; handle and ax steel.

Fig. 12 shows German foot-soldier's poleax, end of the fourteenth century; handle dark wood, ax steel.

Fig. 13, English foot-soldier's Jedburgh ax, sixteenth century; handle wood, ax steel, studded with large brass or steel nails. All these axes are about the same length, and the instructions for making No. 10 in Fig. 5 will apply to these.

Fig. 14 shows a war hammer, fifteenth century, about 3 feet in length. The lower half of the handle

is wood, covered with red velvet, with a golden or yellow cord wound over it; the upper half of the handle steel, as also the hammer and spike. The entire handle should be made in one piece, then the hammer fixed in its place. The spike having a peg at its lower end, and well glued, can be firmly placed into position by the peg fitting into a hole made for its reception in the top of the handle. Finish up with tinfoil.

Fig. 15 is a French partisan, sixteenth century, the entire length about 6 feet 6 inches; the handle round, and the same circumference the whole length, covered with crimson cloth or velvet, and studded all over with round-headed brass nails; the spear-head steel, and about 15 inches in length from the point to where attached to the handle, the widest part of blade, from the left to right-hand spear point being about 8 inches, the depth of tassel or fringe about 4 inches.

Fig. 16 gives a German military fork, sixteenth century, length about 5 feet; handle wood, bound with stout cord in spiral form, the whole then painted dark; the entire length of the fork, from the handle to the points, about 10 inches; the fork steel.

Fig. 17 is a Swiss halberd, sixteenth century, about 7 feet from the point of spear to the end of handle, which is square; the spear and ax steel, handle plain dark wood. The decorative holes seen in ax can be made with center-bit and brace, or burnt out with red-hot iron rods, the holes being about ¼ inch diameter.

Fig. 18 shows Austrian officer's sponton, end of the seventeenth century, about 6 feet in length; round wooden handle. The spear-head, from its point to where fixed on handle, about 9 inches in length; the edges of spear sharp. The cross-bar which runs through the foot of spear can be made in two pieces and glued into a hole on each side. The length of this bar is about 5 inches. The small circular plate through which the bar is fixed can be cut from a piece of cardboard and glued on.

Fig. 19, an Italian gisarme "glaive," sixteenth century; engraved steel, round wooden handle, painted black or dark brown; the entire length about 6 feet 6 inches; length of metal-work from point of spear to where it joins on to the handle or staff 18 inches.

Fig. 20, a Saxon voulge, sixteenth century, 6 feet in length; round wooden handle, steel ax or blade; sharp at the outer edge, and held on to the staff by two steel bands, which are part of ax. These bands can be made of cardboard and glued on to the wooden ax. The above bands can be made very strong by covering them with linen or calico glued on. On the top of handle will be noticed a curved spear point. Carve this from a piece of wood, and cover with tinfoil; the band of metal down the side of handle to be of cardboard covered with foil, and fixed on with round-headed nails, brass or steel.

Fig. 21, a German halberd; a very handsome weapon, sixteenth century, about 6 feet 6 inches entire length; round wooden handle or staff; the bottom of staff has a steel ornament. Length from spear point to lower end where joined on to staff 14 inches; extreme width of ax 16 to 17 inches. On this ax the amateur armorer will be able to display his ability with the fret or keyhole saw. Sharp on the outer and inner edges of the crescent-shaped part of ax.

Fig. 22, an Italian ranseur, sixteenth century, 6 feet long; round staff or handle; entire length of metal part from point of spear to where it joins staff 15 inches; sharp on the outer edges.

Fig. 23, a tilting lance, used in tournaments with vamplate, sixteenth century; wooden pole, covered with cloth, or painted dark color; at the end is a four-pronged piece of steel; the vamplate is of steel; the vamplate can be made of cardboard, and studded with brass nails after it has its covering of foil; extreme length about 9 feet. To construct the above weapons, the same method should be employed as that for the swords, maces, battle-axes, etc., already described; the tassels, or fringe, which is used to decorate the handles or poles can be made from a few inches of worsted fringe, red for preference, about 4 inches in depth, and wound round the staff twice, and fixed in its place with brass-headed nails.

(To be continued.)

CONJURERS OF THE PAST.*

PRECURSORS OF THE MODERN MAGICIAN.

BY ARTHUR WATSON.

MIRACULOUS appearances or disappearances have been, and still are, effects much valued by conjurers. When science was restricted to the priests it would appear that they used it in ways akin to those in which the modern conjurer conducts his performances. The visions and magical appearances of deities such as those related by Pliny and Iamblicus were probably produced by means of plane or concave mirrors. The images were sometimes thrown on to a cloud of smoke, which increased the mystical effect, and rendered them more generally visible.

Salverte gives the following passage from Damascius: "There appeared on the wall of the temple a mass of light, which at first seemed to be very remote; it transformed itself, in coming nearer, into a face evidently divine and supernatural, of a severe aspect, but mixed with gentleness, and extremely beautiful. According to the institutions of a mysterious religion the Alexandrians honored it as Adonis."

Mediæval accounts of miraculous appearances and disappearances are related with credulity, and it seems as if the recorder, having witnessed some sight which aroused his wonder, allowed himself to put the interpretation on it which the creator desired—as if the spectator at the theater should affirm that he saw in reality the objects which are painted on a scene. Possibly it is due to such ready credulity that the conjuring effects of Albert Bishop of Regensberg are related by Johannes Beka.† The story is as follows:

Albert of Regensberg invited King William of Holland in Epiphany, 1247, to a banquet. The bishop led the king from the dining room into his garden, where servants of wondrous beauty were preparing everything for a jovial meal. It was winter time, the whole surface of the earth was thickly covered with snow, and the nobles who accompanied the king began to grumble at being expected to sit down to meat in a garden and without a stove when the weather was so bitterly cold; but when the bishop sat down with the king, and the guests, each according to his rank, had taken their seats and were awaiting the dishes, the huge mass of snow and ice vanished in a moment, the heat increased under the beams of the sun, the grass sprang up, and flowers of extraordinary beauty blossomed. Every tree was covered with green leaves, and brought forth ripe fruit. The vine trees blossomed and brought forth fresh grapes in abundance; the birds twittered and sang. The summer heat was so powerful that the guests had to take off some of their clothes, and they sought the shade under the thick foliage of the trees. After the banquet was over, in a moment the servants, birds' song, the foliage vanished—the snow returned, the guests put on their coats, and returned shivering to the fire in the dining room.

Again, according to the story given by Martin del Rio in his "Disquisitionum Magicarum,"‡ Zedekiah, a Jew, in the ninth century, in the time of the Emperor Louis, suddenly produced in the midst of winter a most pleasant garden in the palace of the emperor, with trees, flowers, grass, the songs of birds.

The sudden appearance of the vine around a dinner table is included among the wonders which may be performed through magic by Vives, in his "Comment. ad Augustum de C. D.," lib. 10, cap. 16, when he says that books have been written about such things which are easy to do.*

Wier, in "De Præstigiis," 1566, tells of an illusion, related also by Lercheimer, about a conjurer in Magdeburg, who complained that his performance brought him in so little money that he wanted to mount to heaven. Accordingly he threw his pony's bridle up in the air, the pony followed, and the conjurer hung on to its tail; thereupon his wife caught hold of his coat, and the maid followed. The bystanders saw this with astonishment, when a man came up and asked what was the matter. They replied that the conjurer and his pony had ascended to heaven, whereupon the man said that he had seen the conjurer enter an inn, and when the people found that they had been the subjects of an illusion they went away. Possibly this was some optical illusion credulously accepted as being real in the first place by spectators unused to such sights.

A certain fascination attaches to fire tricks, and the modern fire king has many percursors. Simon Magus was supposed to have been impervious to fire. Pyrrhus, according to Plutarch, had a great toe which fire would not burn, and Athenæus writes of a conjurer named Xenophon, having as his disciple and successor Cratisthenes, who brought fire from all parts of his body. Reginald Scot says, "Others likewise have (as they say) a Katherine wheel upon their bodies, and they saie they are kin to St. Katherine, and that they can carry burning coles in their bare hands and dip their said hands in hot skalding liquor, and also go into hot ovens. Whereof, though the last be but a bare jest, and to be doone by anie that will prove (as a bad fellow in London had need to doo, making no variance at all therein), yet there is a show made of the other, as though it were certeine and undoubted; by anointing the hands with the juice of mellowes, mercurie, etc., which for a little time are defensatives against the scalding liquors and scortching fiers."

Fromann, in his "Tractatus de Fascinatione Novus et Singularis," 1675, says that the skin may be so hardened by magic art that it does not feel the fury of fire, as in the case of Simon Magus, who, when placed in the flames, did not burn, and was proof against hard and sharp objects, and against all arms and balls shot from bombards. This art, he says, was called *die Passauer-Kunst*, because it first became known when the army collected around Passau, which afterward, in 1611, burst into Bohemia and occupied Prague. (Senertius, lib. 5, "Princ. Med.," page 521).

Antonio Paullini, writing about 1717, says that, forty years before that time, a French fire-swallower was seen in many parts of Germany, who had by him a vessel full of glowing coals, from which he kept on putting them into his mouth, first with one hand and then with the other, and then chewed and swallowed them. He took a piece of meat and put it on the hot coals in his mouth, and there cooked it, and ate it as if it were a delicacy. He set light to sulphur and pitch, and swallowed them with their blue flames in his throat, so that a hissing sound was produced. He would take a glowing piece of iron and lick it with his tongue so that it hissed, or he would take it between his teeth, and carry it for a time around the theater. Paullini also describes Jean Royer's performance of lighting brandy in his mouth, and petroleum which burned without wick.

Martin del Rio, quoting Thomas Farellus, deca. 2 "Rerum Sicularum," lib. 5, cap. 2, says that Eunus, while speaking, sent forth flames from his mouth, which was not to be attributed to devil's magic but to the fact that he had hidden in his mouth a nut full of sulphur and fire, by which he gave forth flames by breathing lightly on it. Del Rio also states that Farellus refers to a certain Diodorus doing the same thing (cap. 1, lib. 3, deca. 1).

Similarly, as St. Jerome says, Barchochebas, who put himself at the head of the Jews in their revolt against Hadrian, made them believe that he was the Messiah by vomiting flames from his mouth. Modern conjurers put a ball of tow in their mouths, let it burn out almost entirely, and add fresh pieces to revive the fire. The sparks are too feeble to injure them provided that they breathe the air through the nose.

Records remain of two conjurers before the end of the seventeenth century who have performed tricks with water, viz., Manfred of Malta, and Jean Royer of Lyons. The former is represented in an engraving of the seventeenth century in the Germanische Museum at Nuremberg.* Here he appears sending forth three separate streams from his mouth before a company of spectators; there are also represented nine vessels, doubtless for the reception of liquids of different colors which he miraculously produced. Between an angel and the sun are the words *Solus sicut sol*, and beneath the angel the words *Fama volat*. Another angel offers him a wreath, which is the *præmium virtutis*. In the Nuremberg Museum is also an advertisement† of his performance headed *Fama volat*, setting forth that Manfred, in addition to his water tricks, would lift a stone weighing 700 pounds by the hair of his head, would fly down rope from the height of a house, etc.

Abraham a S. Clara says of this performer's water

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* Abstracted from the Reliquary and Illustrated Archeologist.

† Fontes, ed. Böhmer, ii. 438.

‡ Cologne, 1657.

* Transeo quæ ex magia naturale fiunt, subito apparere convivas omnes truncos, aut asinis capitibus, extendi per triclinium vitem. Quorum rationem plurimi norunt, nam libri his de rebus sunt conscripti & factu facilia sunt quanto magis Dæmones qui nobis & agilitate præstant & peritia rerum naturæ hæc norunt?

* Reproduced in Hampe's "Fahrende Leute," p. 119.

† Ibid., p. 113.

tricks that he could perform them four times a day. He had a vessel full of lukewarm water brought and fifteen or twenty glasses. First he opened his mouth in order to show that he had nothing between his teeth, then from his mouth came red wine, water, brandy, rose water, orange water, white wine, and the like, which could all be recognized by the taste; but it was noticed that on every occasion he began with red wine. Sometimes, after taking water to the extent of twenty glasses, he would squirt it aloft from his mouth like a fountain. Cardinal Richelieu imprisoned this Manfred, and threatened to hang him if he did not prove that his tricks were performed by natural means and not by magic. Manfred revealed the *modus operandi* in secret, and was set free.*

Scotus has given an account of the means of production of different colored liquids in his "Natural Magic." When he was in Rome he was invited, together with Kircher, to the house of a certain antiquarian. The latter produced a roughly-carved cup, of which he wished to know the use. Kircher asked for water, and found that the cup, which was made of light wood from Mexico, changed the color of the water which was poured into it, and that various colors could be shown by varying the light and shade, and by placing it against various colored pieces of cloth. At first the water poured into the cup became pure blue—the longer it stood the deeper it became. If the water was poured into a glass bowl and placed in the light all trace of the blue color vanished; but if the bowl was placed in the shade the water took a beautiful green tint; it became red, and afterward it assumed the color of various colored cloths placed against it.†

The second of the two conjurers referred to above was celebrated for his fountain tricks. Jean Royer of Lyons could send forth from his mouth, according to the account given of him by Abraham a S. Clara, twelve or fifteen different colored liquids, leaves, and flowers; also he exhibited a fountain playing high from his mouth, and for as long as it would take a man to say twice over the fifty-first Psalm.*

Royer, like Manfred, was said to have aroused suspicion that his performances were practised by devil's aid, and to have saved himself by revealing the tricks to Scotus and Kircher, who accepted his explanation and undertook to keep the secret during Royer's lifetime. After a time Scotus appears to have too hastily concluded that, as he had heard, Royer was dead, and to have revealed the trick while Royer was still living.

An explanation of Royer's trick is given in the "Zeitkurtzende Lust- und Spiel-Haus," the performer being supposed to take on an empty stomach water colored with certain substances which, being diluted with the varying quantities of the water which he drank, produced liquids like in color to varying kinds of wine. Vinegar, lemon juice, and brandy were added to give a flavoring.

Another performance of the same kind as those of Manfred of Malta and Jean Royer of Lyons is described in what appears to have been a book leaf preserved among the prints in the British Museum. It is a portrait of Floram Marchand, who is styled Le Grand Boyeur de Tours, and beneath is printed:

"See here the pourtrait of this man of Tours,
His art and reasons here are published.
What makes this glass look white and that so red:
And all the progress of the works displaid—
The whole deceit is here now open laid."

The book, or pamphlet, dated 1650, is by Mr. Thomas Peedle and Mr. Thomas Cozbie, who brought the conjurer "into England from Tours, in France; and after Wednesday next, being the 26th of this present June, will be constantly ready every afternoon, if desired, in their own persons to work an experimental proof of what is here declared."

Wier, in "De Præstigiis," says: "The many feats which minstrels and jugglers perform every day by agility and swiftness of hand seem to those who are skilless to be miracles, and we are lost in admiration of them." Pomponatius states that at Mantua and Padua he saw a man of this kind, called Reatius, who did incredible things which seemed to the vulgar to be performed by the aid of demons; accordingly he was given over to the authorities on a charge of heresy, and showed in secret that his actions were only illusions, and were either tricks of legerdemain or carried through by secret confederacy with many other persons.* Reginald Scot divides confederacy into two kinds—private and public, the private being some pre-arrangement† and, further, when another person or other persons are in league with the performer. As an example of private confederacy he gives a card trick. "The conjurer will show you a card or any other like thing, and will saie further unto you, Behold, and see what a marke it hath, and then burneth it; and nevertheless fetcheth another like card so marked out of some bodies pocket, or out of some corner where he himself before had placed it, to the wonder and astonishment of simple beholders, which conceive not the kind of illusion but expect miracles and strange works."

A trick of public confederacy is such as telling "wether one cast crosse or pile‡ by the ringing" of a coin. This is done by the form of questions asked by the confederate; according as the question is, "What is it?" or "What is't?" the performer knows which way the coin has fallen. Another confederacy trick mentioned by Scot is "How to tell where a stollen horse is become." To perform this it was necessary to get a confederate to steal the horse first, and the conjurer knew then where it could be found.

* For this description Abraham a S. Clara quotes the "Grosser Schauplatzes Lust- und Lehrreicher Geschichte," Part II., Section 126, p. 96.

† Scotus, "Magia Naturalis," p. 1, l. 4.

* The duration of the operation of this mouth fountain is estimated in Paullini's "Curieuses Cabinet" as the time it takes to cover two hundred paces.

* Multa insuper imperitoribus visa miracula, manuum expedita agilitate et industria quotidie ab histrionibus et ioculatoribus fieri videbimus, miramurq: narrat Pomponatius, se Mantue et Patauij quendam ejus generis hominem Reatium nuncupatum vidisse, qui incredibilia operabatur, eaq; demonum arte perfici vulgo credebantur: quare ab hereticæ pravitatis inquisitoribus subditus quæstionibus bona fide occulto ostendit fraudulentas esse suas actiones, merasque manuum agilitates, et multis secreta intelligentia colludentibus peragi.

† When one (by a speciall plot paid by himselfe without anie compact made with others) persuadeth the beholders that he will suddenlie and in their presence doo some miraculous feat, which he hath alreadie accomplished priuilie.

‡ Or, as we say, "head or tail."

THE ROTATION OF THE EARTH.

HOW IT IS MECHANICALLY PROVED BY BLUM'S APPARATUS.

BY J. G. DAVIS AND H. F. PURDAY.

EXPERIMENTS have lately been made by M. Blum, with a simple apparatus, designed to demonstrate the effect of the rotation of the earth on the plane of oscillation and support of a simple pendulum.

The apparatus reproduces in all particulars the well-known observations of Foucault, an account of which was published in February, 1851.

The deductions then made by him were based on the results of suspending a heavy weight by a fine wire from the dome of the Pantheon, the upper extremity of the wire being attached to a steel point bearing in a steel cup. The pendulum being thus free to swing in any direction, a trace of its path was left in sand by a fine point attached to the bob.

The marks made by successive swings showed that the plane of oscillation of the pendulum revolved with respect to the building.

Foucault concluded that the plane of oscillation must in any latitude appear to make a complete revolution in 24 hours × cosec. lat., so that at the equator the plane was stationary, and at the poles revolved once in 24 hours.

It is clear from the above that the latitude of any point on the earth's surface can be obtained by finding the angle whose cosec. is equal to (time in hours for a complete revolution of the plane of oscillation and support of a simple pendulum freely suspended at that point) ÷ (24 hours).

These results have lately been verified by M. Blum's simple apparatus, consisting essentially of a pendulum which can oscillate on a sphere at any latitude.

A small pendulum, composed of a slender strip of wood, 2½ inches long, weighted by a small wooden ball, is employed.

This is carried by a gibbet attached to a rectangular platform, mounted on a carriage. The latter slides in a groove cut along a demi-meridian of a sphere about 9 inches in diameter, which can rotate in either direction about a vertical axis, so that the pendulum can be placed in any desired latitude by means of a clamping screw. The pendulum, whose axis passes through the center of the sphere, is suspended from the gibbet by a thread, and is controlled by a spiral spring attached to the bob. When displaced from its normal position, it oscillates in a circular opening cut in the platform. A steel hook, which can be fixed at any point on the circumference of the hole in the platform, is used to hold the pendulum displaced from the normal position prior to releasing it, so that it may be started oscillating at any azimuth angle desired. This is supplemented by a self-starting gear releasing the pendulum after it has been set to the required azimuth by the hook.

When the globe is motionless, the hook can be lifted

DIAGRAM I.

INDEX OF PARTS.

A, clamping screw; *B*, carriage; *C*, gibbet; *D*, thread; *E*, wood strip; *F*, wood sphere; *G*, fixed great circle; *H*, ball joint; *J*, Starting rod; *K*, spring; *L*, demi-meridian slot; *S*, hook and catch.

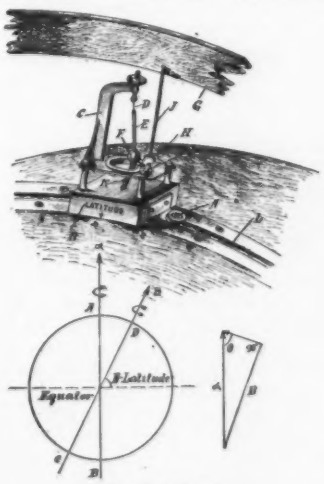

DIAGRAM II.

with the hand, and, when rotating, it is lifted by a catch engaging with the inner edge of a fixed great circle surrounding the globe.

The following results are recorded:

(*a*) The plane of oscillation of the pendulum is invariable in direction, whatever may be the latitude of the pendulum and the azimuth in which it has been launched. This would, of course, be observed on a star without rotation.

(*b*) 1.—With the globe rotating, after a quarter of a turn, it is noticed that if the pendulum is at the north pole its plane of oscillation remains fixed in space—turning relative to the globe in the opposite sense, and at the same rate.

2.—With the pendulum at any other northern latitude, the plane of oscillation rotates relative to the globe with a speed proportional to the sine of the latitude.

3.—The speed of the plane of oscillation of the pendulum relative to the globe is zero at the equator for all speeds of the globe.

4.—In the corresponding southern latitudes the rates of rotation of the plane of oscillation are the same, but their sense is changed.

The proportionality of the speed of rotation of the plane of oscillation to the sine of the latitude is readily proved by the representation of angular velocities by vectors.

Let the vector a represent the angular velocity of the globe about the axis *AB*.

The vector representing the angular velocity of the globe about *CD* is the resolved part of a long *CD*, and is equal to $a \sin \theta$ (i. e., $a \sin$ lat.). This is β.

Clearly when $\theta = 0$ $\beta = 0$, agreeing with (3).

Also when in the southern hemisphere the apparent sense of β is changed, as observed in 4.

Another piece of apparatus, simpler than the preceding, but which does not yield such good results, may be used to demonstrate the change in sense of the deviation as one passes from one hemisphere to the other.

A gibbet carrying a pendulum similar to the one described above, but larger, is held in the hand, and its axis is caused to describe a cone with a vertical axis.

The conical motion of the axis of the pendulum causes the plane of oscillation to revolve with respect to the gibbet, the sense of rotation of the plane of oscillation being clockwise or anti-clockwise, according as the apex of the cone of revolution points upward or downward, or *vice versa*.—Knowledge and Scientific News.

ENGINEERING NOTES.

Wood preservation in the United States in 1908 required over 56,000,000 gallons of creosote and nearly 19,000,000 pounds of zinc chloride, with small quantities of crude oil, corrosive sublimate, and other chemicals, according to the United States Forest Service. Nearly seven-tenths of the creosote was imported, mainly from England and Germany.

The making of tin-plates originated in Bohemia, according to a recent paper by William E. Gray, hammered iron plates having been coated with tin in that country some time before the year 1600. Tin-plate making was introduced in England in 1665, the art being brought there from Saxony. In France the first tin-plate factory was established in 1714. The first commercial manufacture of tin-plates in the United States was at Pittsburg, in 1872.

The extensive subway system which has been designed for the city of Berlin is likely to be constructed in the near future. The Municipal Council approved the project about four years ago, but it has taken all the intervening time to clear the various difficulties which came up. Since the project has received the Emperor's sanction not long since, there remains but little in the way of its completion. At present the plans call for a line which connects the wards of the north district with those of the south, and the total length of the underground line will be about 12 miles. It is to have 14 stations along the course and the trip will take about 18 minutes, using the standard speed of 40 miles an hour. The work of construction is to be commenced at an early date, and the estimated cost of the project is $18,000,000. It is also proposed to extend the line from the city to the populous suburb of Reineckendorf, this by the use of an elevated way, and the system may eventually be extended to other suburbs of Berlin.

The United States Navy Department has ordered the establishment of yearly steaming contests between battleships, armored cruisers, destroyers, and torpedo-boats. Owing to the varied duty, steaming under widely different conditions, with different grades of coal, and the lack of sufficient data to place other vessels of the service on an equal basis for competition, only these classes of vessels will enter into the first competition. Standards for the different classes of vessels have been established from experience gained in the past; and, while certain ships may be favored in some instances, every effort will be exerted by the department to adopt such measures in improving the machinery where demonstrated to be necessary in order to even conditions. The winning vessels will receive suitable trophies, which will be carried for the following year in some conspicuous place, and the name of the vessel with the year she won it will be inscribed on each trophy. The commanding officers and engineer officers of the winning vessels will receive commendatory letters from the department, copies of which will be filed with their records. Money prizes will be given to the men of the engineers' force of the winning vessels, but no man not actively engaged on his station during one of the full power trials will be entitled to prize money.

Boring is of but little value for tracing mineral veins, owing to their going down so nearly vertically and to their great irregularity, but it is often used to locate irregular masses of ore; for example, bore holes have recently been employed successfully in Cumberland for proving deposits of red hæmatite in the Carboniferous limestone, even where this is overlain by Triassic rocks. Obviously bore-holes are most valuable when stratified deposits have to be tested, and everyone will remember the conspicuous success that attended their use in proving the permanence in depth of the auriferous blanket beds of the Witwatersrand. The deepest bore-hole put down up to the present is one at Paruschowitz, in Upper Silesia, which attained a depth of 6,573 feet; it commenced at a diameter of 12.6 inches and finished at 2.7 inches, and it is easy to imagine the difficulties that attend the boring of so small a hole to the depth of 1¼ miles. Bore-holes such as these are now always made by means of the well-known diamond drill, which brings up a core of the rocks passed through, and thus affords positive information respecting them. Unfortunately, the only kind of diamonds suitable for this purpose, the dark opaque stones, showing no distinct cleavage, known in the trade as "carbons," are very scarce and proportionately dear, so that diamond-drilling is now a very costly operation. We are within measurable distance of seeing such "carbons," or at any rate "bort," produced artificially. For rocks of moderate hardness, these diamonds have of late years been replaced to some extent by shot made of specially hard chilled iron, but these are of little use in the harder rocks. One of our greatest needs at the present moment is a metal that shall be strong, tough, and very considerably harder than quartz; the production of such a material would conduce more to the technical advancement of several branches of mining than almost any other discovery that could be named.

ELECTRICAL NOTES.

To cut across a glass bottle or other vessel, a scratch about ¼ inch long is made either on the emery wheel or by means of a file, and a thin resistance wire, passing through the scratch, is wound tightly round the vessel in a single loop, between the crossed ends of which a small piece of asbestos paper is placed. This wire is connected by means of two pieces of insulated copper wire with the mains (110 volts), a suitable rheostat being inserted in the circuit so that the current is just sufficient to heat the resistance wire to dull redness. In this way the crack formed follows exactly the course of the wire.—Am. Chem. Soc. Jour.

In a paper read before the American Institute of Electrical Engineers by Mr. Stott on the cost of power, a number of curves are given for the cost of power at the bus-bars per kilowatt-hour for reciprocating steam plant, steam-turbine plant, reciprocating engine combined with low-pressure turbine plant, gas engine, gas engine and steam turbine, and hydraulic plant. The ordinates of the curves are in mills per kilowatt-hour and the ordinates of the percentage load given to 150 per cent, or 50 per cent overload. One curve is given for fixed charges, and two for coal and water, and also for total operating charges. In addition there are other curves given connecting cost per kilowatt-hour with the time by the clock both for winter and summer lighting loads, and railway loads. It must, however, be remembered that many of the items of cost are very indeterminate, such as foundations, cost of labor, etc., so that the curves in this paper are given with the idea that they may form a guide to show at least the fundamental relations between the various items going to make up the cost of power, and at the same time what is actually being done at the present time in large plants which have a maximum load of over 30,000 kilowatts.

The new Mont Blanc electric railroad is making considerable progress, and a part of the track has been already laid. It starts at Fayet, which is the terminus of the railroad controlled by the Paris-Lyons-Mediterranean Company, leading from Geneva. The line proceeds upon a 1.6 per cent gradient for a distance of 5 miles, climbing the slope and reaching a high point known as the Col de Voza, from which there is an extended view. This point lies at an altitude of 5,610 feet. From here the line continues to mount in an easy grade, and at the 10-mile point it reaches the Tete Rousse, which is surrounded by glaciers and lies at 10,420 feet altitude. The line proceeds up the mountain side and reaches the elevated peak known as Aiguille du Gouter, after passing through a long and winding tunnel. From this point there is a remarkable view over the Alpine region. As regards the progress of the line, the track has been laid as far as the Col de Voza, using a 40-pound rail, which is laid on metallic ties. The line is of 35-inch gage and uses the Strub rack-rail system. Besides the end stations there will be seven intermediate stations, and the trip will take about four hours. It is proposed to use a sleigh service so as to reach the summit of Mont Blanc, and this latter will take about five hours for the round trip, so that from Fayet to the summit and return will take about 13 hours. The line will be operated from June to September.

Some time ago we made a brief mention of the new electric locomotives of the Simplon line, but at present there have appeared more complete data. Like the former locomotives, they are designed to run upon 3,000 volts three-phase current, taking the current from overhead wires. The new locomotives show several innovations. They have four speeds where the old ones have but two, and this is an important step in the problem. The length between buffers is about the same, or 40 feet. Four driving axles alone are used at present, while the other type had three driving and two carrying axles. These latter have now been dispensed with. Each axle receives a load of 19 tons. The outer axles have a lateral and radial play as the locomotives need to travel on corners of 900 feet radius, but the two inner axles have no such play. In order to run more easily in the curves, the wheel diameter is reduced to 25 inches. The two motors are fixed at the middle of the chassis, and drive all four wheels by cranks and driving bars. While keeping the former speeds of 20 and 40 miles an hour, the motor poles can be changed by switching, so as to give two other speeds of 30 and 15 miles an hour. The armature is of the squirrel-cage type, and this is the first instance of its use on a 900-horse-power motor. At each end of the locomotive is a transformer for supplying the motor at different voltages, working at ten points of 200 volts each from zero up to 1,000 volts. The weight of the new locomotives is 75 tons. It is to be noted that the power of the locomotives is much above what is needed for running the train in the Simplon tunnel, but it is desired to provide for an increase in the weight of the trains as well as for an extension of the electric section from Iselle, at the tunnel mouth, to Domo d'Ossola, on which there is a 2.5 per cent gradient.

TRADE NOTES AND FORMULÆ.

To Attach Copper to Glass.—1 part caustic soda and 3 parts rosin, are boiled in 5 parts of water and mixed with the same quantity of plaster. This cement is not affected by water, heat, or petroleum. If in place of plaster of Paris, zinc-white, white lead, or slaked lime is used, the cement will harden more slowly.

Cement for Making Cast and Wrought Iron Tight.—600 parts of fine iron filings, purchasable as limatura ferri, 20 parts powdered sal ammoniac, and 10 parts of flowers of sulphur, are mixed into a paste with water, to which 20 per cent of vinegar or a few drops of sulphuric acid has been added, the mixture applied to the cleaned spots and firmly pressed in.

Solid Lye, for Washing and Bleaching.—The composition consists of 100 parts common salt crystals, 10 parts rosin, 50 parts of sodium or potassium silicate, 12 parts sea-weed jelly. For articles more difficult to cleanse, lime milk, in suitable quantity, is added. For laces, fine linens, etc., soap extract is added. The above substances are thoroughly mixed and formed into cakes or blocks and allowed to harden.

Cement for Acid Vessels.—Damaged porcelain, glass, and other vessels, used to keep acids in, can be cemented by means of a mixture of one part each of asbestos and fine sprinkling sand and 3 to 4 parts of soda water glass (30 deg. Bé.). The mass is plastic, speedily dries in the air and is fireproof. After being exposed to the acids kept in these vessels, the mass is waterproof, although it could before this be softened in water.

Alloy for Casting Natural Objects, such as fruits, leaves, beetles, snakes, lizards, etc.—Lipowitz metal: 4 parts tin, 8 parts lead, 15 parts bismuth, 3 parts cadmium. This, the easiest melting metal mixture, softens at 55 deg. C. (131 deg. F.) and is completely fluid at 60 deg. C. (140 deg. F.). Wood's metal: 2 parts tin, 4 parts lead, 5 to 8 parts of bismuth, and 1 to 2 parts of cadmium. This silver white looking, very fine grained alloy, melts at 66 deg. C and 72 deg. C. It can also be used, with excellent results, for soldering.

A Durable Varnish for Copper.—A varnish that is to a certain extent proof against heat and acid fluids, but not against alkaline fluids, is obtained by heating the finest, thick fluid amber varnish, so that it becomes sufficiently fluid to be applied with a brush; coat the copper object with it and allow it to rest until the varnish is completely dry. The object is then heated until the varnish begins to smoke and turns brown. If the above described operation is twice repeated, we finally obtain a coating, which in power of resisting acids even surpasses enamel, but which is badly attacked by only weakly alkaline fluids.

Marine Glue (Jeffreys).—Dissolve 1 part of caoutchouc in 50 parts of sulphide of carbon, adding an equal quantity by weight of shellac and make the mass uniform by the application of heat. In place of the sulphide of carbon, purified coal tar oil may be used, sufficient to render the cement fluid. This excellent mixture is used for cementing wood together, for attaching joiner work to wood and iron, caulking of ships, for filling cracks and fissures in masonry, wood, etc. Marine glue resists the temperature at all seasons of the year and possesses great solidity.

To Cleanse Marble Slabs.—I. Rub the slab off with a mixture of 5 parts common salt, 2½ parts each powdered lime and pumice stone, after which wash it off with soap and water. II. 2 parts bicarbonate of sodium, 1 part chloride of lime, mixed with sufficient water to make a thick paste, with which the slab is polished. Finally, wash it off with water and dry quickly. III. Grease spots are removed with a paste of ordinary white clay and benzine and the mixture afterward removed by polishing. If it has been neglected to remove the grease spot at once, the fatty acid will, in time, have caused rather deep damage to the slab, which can only be restored by repolishing.

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